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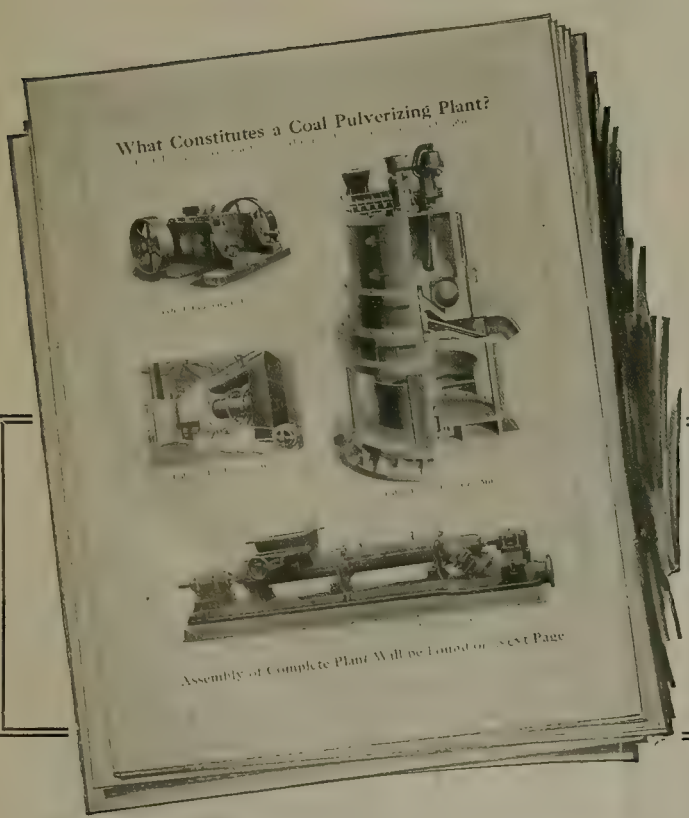
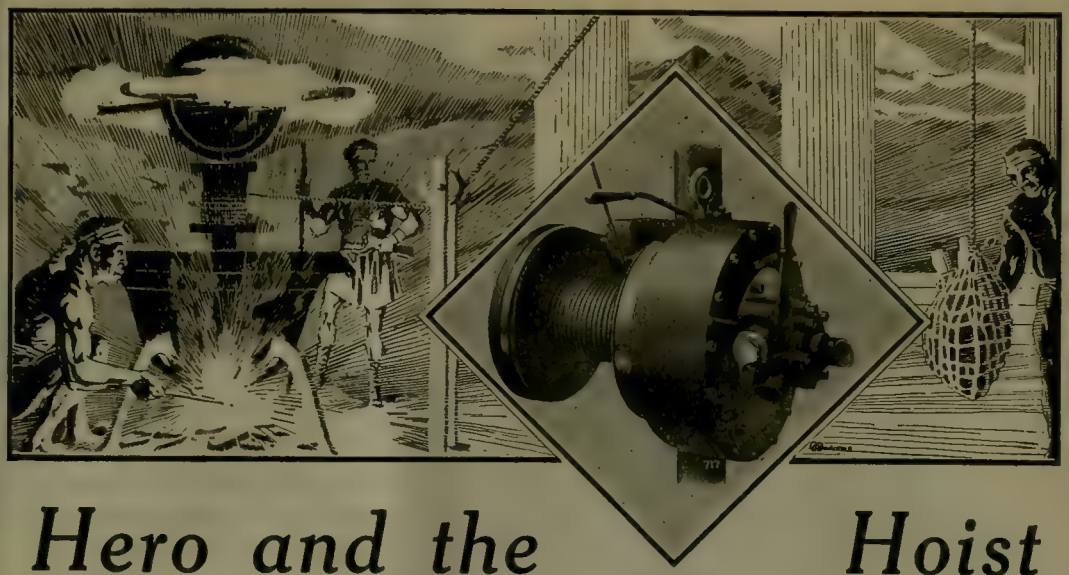


Engineering details regarding the application of Fuller-Lehigh Pulverized Coal Burning Equipment to your boiler plant may be obtained without cost or obligation by writing to us.

FULLER-LEHIGH CO.
Fullerton, Pa.

What Constitutes A Coal Pulverizing Plant?

Fully explained in our Booklet 600-MS which we will be glad to send on request. More than 35,000 tons of coal are being pulverized daily by this method and you owe it to yourself to be posted on details.



Hero and the Hoist

THE first rotary engine described by Hero, the Greek writer of ancient times, was a toy.

BUT now, after sleeping 3,000 years, the rotary idea of Hero's toy, incorporated in the new Waughoist, is solving the lifting problems of the mining industry and speeding up hoisting operations everywhere.

BY minimizing friction in this remarkable new engine, the ideal of its manufacturers has been attained—greater power from less air, longer life and completely satisfactory service from every point of view.

LET us tell you more about it. Write today for a Waughoist booklet.

THE Denver Rock Drill Manufacturing Co.

DENVER, COLORADO

San Francisco	*Los Angeles*	*Joplin*	*Lima*	*New York City*	*Melbourne*
Scranton	*Seattle*	*Wallace*	*Santiago*	*Houghton*	*Johannesburg*
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Canadian Rock Drill Company, Limited
Sole Agents in Canada

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ALL STEEL JAW CRUSHERS
AND
XX STRAIGHT LINE CRUSHING ROLLS

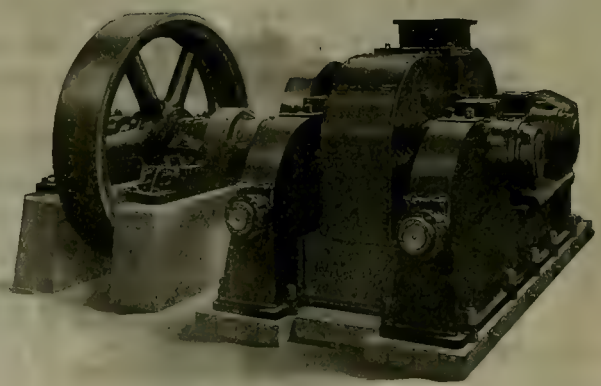
All Steel Jaw Crusher

The massive construction of ALLIS-CHALMERS All Steel Jaw Crushers and XX Straight Line Crushing Rolls, indicates machines that are built for heavy work and Severe Service.

All the latest improvements are embodied assuring Maximum Efficiency and Economy.

Bulletins
All Steel Jaw Crushers
No. 1810

XX Straight Line Crushing Rolls
No. 1816



72" x 24" Style XX Straight Line Crushing Rolls

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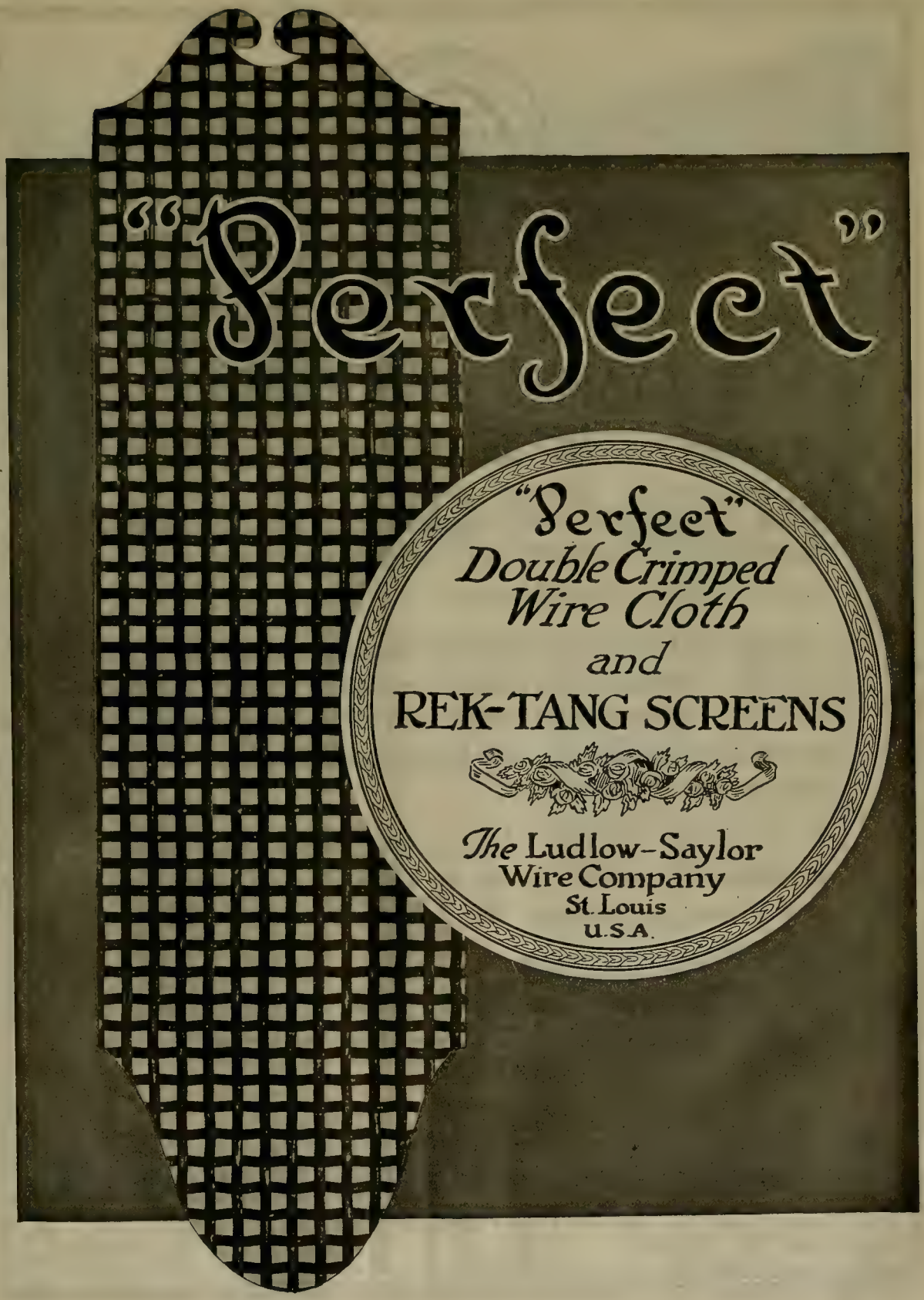
MILWAUKEE, WIS. U. S. A.

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REK-TANG SCREENS
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ONLY IMPORTANT DEVELOPMENT IN CYANIDE MANUFACTURE IN 25 YEARS

Since 1894-1898 there has been only one fundamental improvement in the field of Cyanide manufacture—the discovery of Aero Brand Cyanide.

This product was developed four years ago, to meet an urgent need for lower priced cyanide, in a time of scarcity and high prices. The service performed then by Aero Brand is still at work—Aero Brand is still being sold at the lowest cost of any cyanide on the market.

Its efficiency has been demonstrated under every possible metallurgical condition, under the observation of some of the best mining engineers in the United States, Canada and Mexico.

The almost universal use of Aero Brand on this continent is the best evidence of the service it is rendering in these difficult times.

AMERICAN CYANAMID COMPANY

511 FIFTH AVENUE, NEW YORK

The Braided Jacket adds enormous STRENGTH

And that is but one of the many points of superiority in Indestructible Air Drill Hose. Note the thickness of the rubber cover—it gives ample protection against external injury without the necessity for wire or other armoring.

Here is construction you can see is good. The rubber stocks used throughout are the best—the tube is compounded to resist the effects of oil—the friction strength is unusual and the rubber cover tough and elastic.

These features make Indestructible Air Drill Hose long lived and dependable.

NEW YORK BELTING & PACKING CO.

RUBBER GOODS FOR THE MINING INDUSTRY

Conveyor Belting
Elevator Belting
Test Special Transmission Belting
Indestructible Air Drill Hose
Indestructible Water Hose
Indestructible Steam Hose
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Cobbs Piston Packing
Pump Valves

NEW YORK BELTING & PACKING CO.

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INDESTRUCTIBLE AIR DRILL HOSE

LUNKENHEIMER

"Vigilant" Safety Water Column

A *safety appliance* necessary for protection against the dangers incident to high and low water levels in steam boilers.

THE "VIGILANT" SAFETY WATER COLUMN will automatically sound an alarm and notify the attendant whenever the water level approaches either danger limit. It thereby safeguards life and protects the boiler from serious disaster which may be caused by the low level allowing the fire to play on the crown sheets and tubes when unprotected, or extreme high level which causes priming of the boiler and consequent damage to the power unit and the connecting pipes and valves.

The action of the "VIGILANT" operating mechanism is simple but positive. The single float actuates the double acting valve through the medium of stops set for high and low level limits. When the water approaches either danger limit the valve is opened, permitting steam to pass and blow the signal whistle.

A sediment chamber is provided at the bottom to trap scale or dirt which may enter the Column; Gauge Cock connections are tapped on both sides to permit right or left hand assembly; the top is removable for inspection of working parts, and all parts are renewable.

The "VIGILANT" Safety Water Column is recommended for working steam pressures up to 250 pounds; is made in a variety of sizes to suit all makes of boilers, and from the extensive line of LUNKENHEIMER Water Gauges and Gauge Cocks available a combination can be selected to suit every individual installation.

Specify LUNKENHEIMER "VIGILANT" Safety Water Columns and insist on getting what you specify.

THE LUNKENHEIMER CO.

"QUALITY"

LARGEST MANUFACTURERS OF HIGH GRADE ENGINEERING SPECIALTIES IN THE WORLD

NEW YORK CHICAGO CINCINNATI BOSTON LONDON

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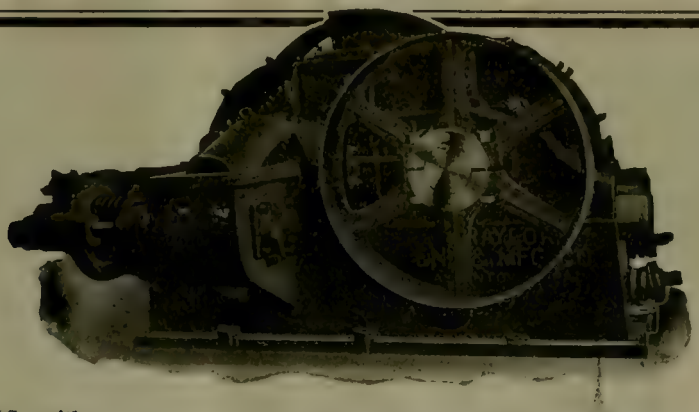
Traylor Rolls



TRAYLOR ROLLS—with roll-shells that remain straight and true because of the patented "fleeting roll" mechanism.

Write for Bulletin PR-2

Traylor-Talks

Leaving aside the important and well-known Traylor Roll patented features such as the "Fleeting Roll', there's another valuable point to be considered when this question of buying a set of rolls comes up.

That question is weight—material contained—inherent strength.

Size for size—compared with others—Traylor Rolls are of heavier construction—weigh more—contain more actual material.

This extra weight in construction counts in the daily grind of service and shows up in a greater percentage of running time, day in and day out.

Write for weight figures on Traylor Rolls and get the facts on the patented built-in "Fleeting-Roll" mechanism.

Traylor Engineering and Mfg. Co.

ALLENTOWN, PA.

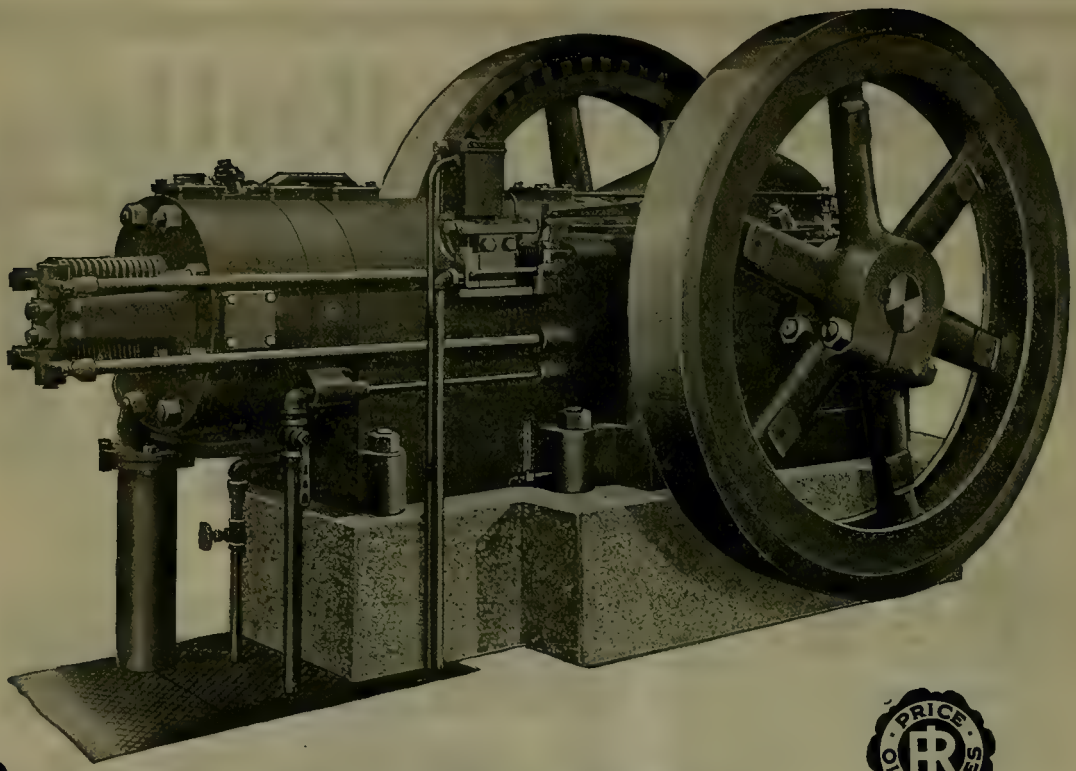
New York Chicago Pittsburgh
Los Angeles Spokane

Truck and Tractor Division:

CORNWELLS, BUCKS CO., Pa.

FOR IMMEDIATE DELIVERY
10"x20" BLAKE STYLE JAW CRUSHER
10"x72" "BULLDOG" JAW CRUSHER
28"x36" "BULLDOG" JAW CRUSHER
2 No. 6 GYRATORY CRUSHERS
36"x16" "A" CRUSHING ROLLS
42"x16" "AA" CRUSHING ROLLS

TRAYLOR TRUCKS, LIKE "BULLDOG" CRUSHERS, GIVE THE MAXIMUM SERVICE AT A MINIMUM UP-KEEP COST.



PRICE OIL ENGINES

It should not be a question of installing "an engine to do the work" but in equipping your plant with the machinery which will do the work under your operating conditions.

Your best assurances of this service are the names of companies whose products you know to be everlasting monuments to their credit.

First, we ask you to associate Price Oil Engines with Ingersoll-Rand. These engines are built and sold by the same staff responsible for the present reputation and service of Ingersoll-Rand Compressors, Vacuum Pumps, Rock Drills, etc.

Price Oil Engines are rugged, compact and simple. They have the economy of a Diesel Engine and the simplicity of a steam engine.

Ignition is by temperature of compression—there are no hot bulbs or plates. This feature has reduced starting and other common oil engine troubles to a minimum.

Fuel injection is direct and positive without the use of compressed air. With Price engines no expensive high pressure air compressor and fittings are necessary.

These and other features have made it possible for us to offer a simple and reliable engine.

The distinctive and simple oiling system and careful construction of the engines permit us to guarantee a consumption of only one gallon of lubricating oil per 4000 HP. hours.

The single cylinder, horizontal engine shown above is known as the Type "PO" and is built in 45 and 90 HP. sizes. We also offer multi-cylinder, vertical engines in sizes ranging from 105 to 1000 BHP.

These engines are suitable for driving generators, compressors, line shaft—in fact for all general power purposes.

Our Engineers will be very glad to tell you more about Price Engines. In the meantime let us send you complete information

INGERSOLL-RAND COMPANY

11 Broadway, New York

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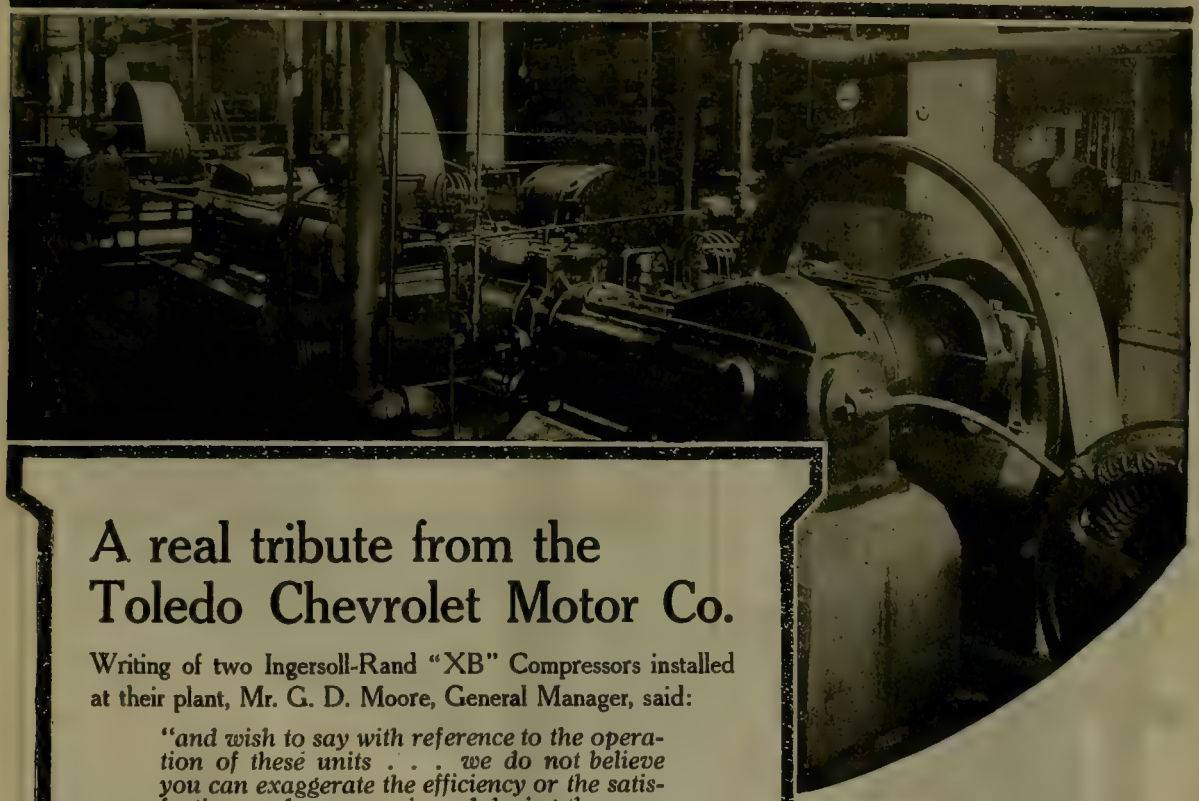
Ingersoll-Rand

"Efficiency and Satisfaction"



A real tribute from the Toledo Chevrolet Motor Co.

Writing of two Ingersoll-Rand "XB" Compressors installed at their plant, Mr. G. D. Moore, General Manager, said:

> *"and wish to say with reference to the operation of these units . . . we do not believe you can exaggerate the efficiency or the satisfaction we have experienced during the years these compressors have been in operation in our plant."*

There is nothing to add to what Mr. Moore has said except that we are glad that his company has secured the same service as thousands of other users of Ingersoll-Rand Compressors.

No matter what the size or type there is an Ingersoll-Rand Compressor to meet your requirements. Our En ineers will gladly discuss your compressor problems with you.

Ingersoll-Rand Company

11 Broadway, New York — 165 Q. Victoria St., London

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OTHER I-R PRODUCTS INCLUDE

Turbo Blowers and Compressors, Condensers, Oil Engines, Rock Drills, Pneumatic Tools, Hoists and Cameron Pumps

PRICE · IR · OIL ENGINES

553-C

Ingersoll-Rand

Sectional Vertical Plunger Sinking Pump.

Capacities up to 155 gallons per minute.

CAMERON

Sectional Vertical Sinking Pumps

These pumps are built in sections, the heaviest single part weighing less than 300 lbs.

Even in the remote interiors of Central and South America, cut off from railroads by mountain ranges, these pumps are delivering true Cameron Service.

Cameron pumping service means reliability and economy combined with simplicity.

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Ingersoll-Rand Company

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Condensers
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PRICE · OIL ENGINES

Air Compressors
Rock Drills
Sharpeners

108-S

Ingersoll-Rand

The A. S. Cameron Steam Pump Works

The leader in a leading industry

TODAY the Chicago Pneumatic Tool Company is a twenty-five-year-old leader in an industry which touches practically every phase of modern engineering and construction work. The company is *more* than the world's largest builder of pneumatic and electric tools—

Chicago Pneumatic Air Compressors are built in 500 types and sizes—*all* modern! Giant Oil, Gas and Steam Engines are built in capacities from 12 to 200 h.p., and if desired, may be supplied as complete electric generating units. Pneumatic Geared Hoists, Sand Rammers, Rock Drills, Coal Drills, Pneumatic Winches.

Electric Track Drills and Vacuum Pumps are other C-P Products — *one great family,* whose homes comprise five American and three foreign plants.

Sales and Service Branches the world over carry stocks of C-P Products, and extend expert engineering counsel without obligation. Inquiries addressed to the nearest Branch will receive prompt attention.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building - 6 East 44th Street - New York

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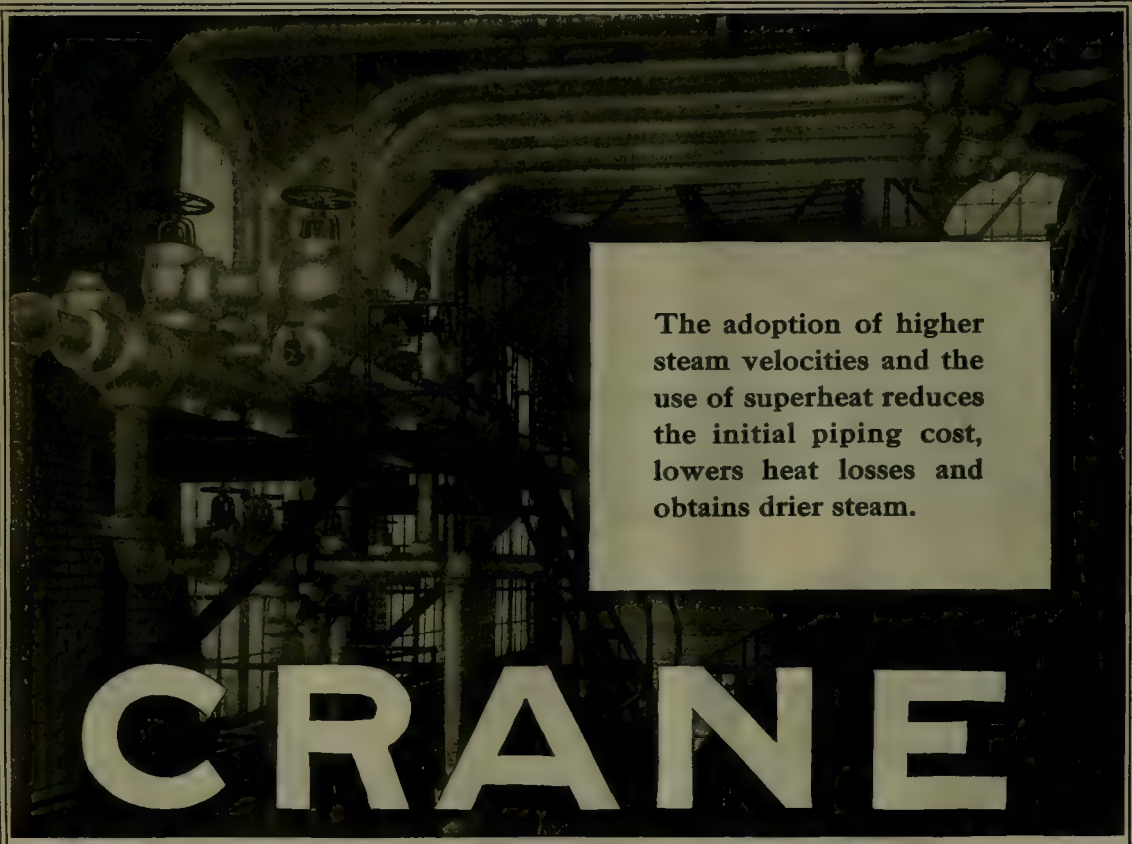
J17

BOYER PNEUMATIC HAMMERS · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · VACUUM PUMPS · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES · ROCK DRILLS · COAL DRILLS

CHICAGO PNEUMATIC

Depend upon *that Name*


The adoption of higher steam velocities and the use of superheat reduces the initial piping cost, lowers heat losses and obtains drier steam.
CRANE

Power Plant Equipment

conforms to the latest methods of modern steam practice.

We make all the necessary valves, fittings and piping to take care of high pressure superheated steam and high or low pressure saturated steam.

We are manufacturers of about 20,000 articles, including valves, pipe fittings and steam sepcialties, made of brass, iron, ferrosteel, cast steel and forged steel, in all sizes, for all pressures and all purposes and are distributors of pipe, heating and plumbing materials.

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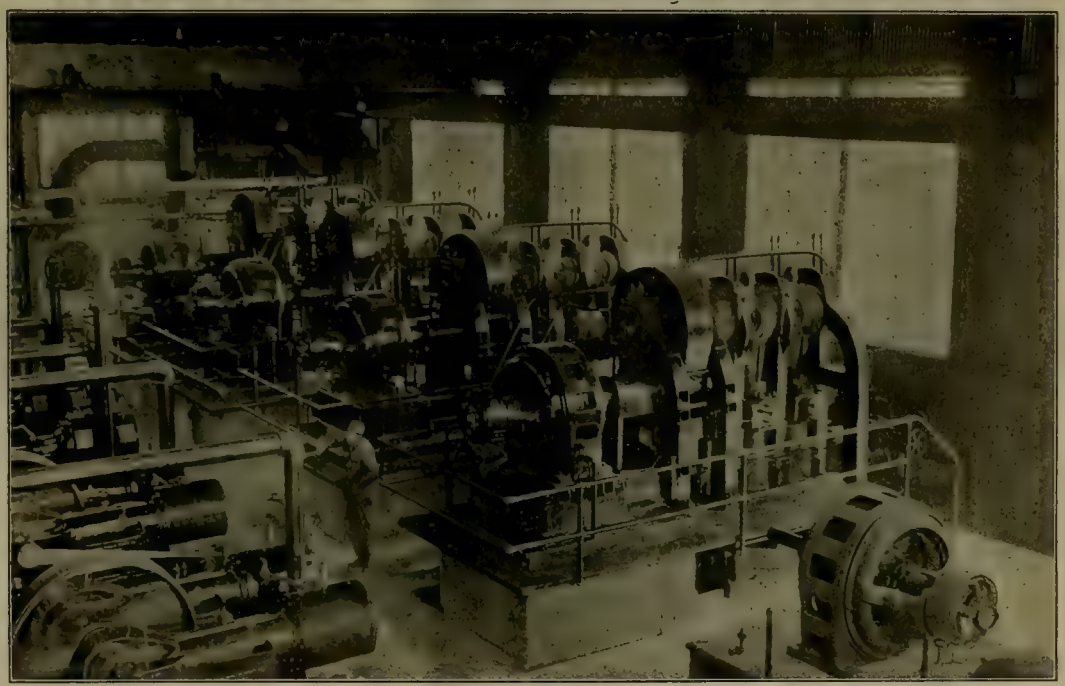
Aldrich Power Pumps



At Inspiration

There's No "Waster's Penalty" Where Aldrich Pumps Are Used

Four Aldrich Triplex Pumps take care of the water supply for the concentration mill of the Inspiration Consolidated Copper Company, of Miami, Arizona.

This Aldrich installation is typical of many among large mines where pumping cost-factors are carefully considered and where Aldrich Pumps have been found to fit exact pumping requirements.

Aldrich engineers have prepared a folder in which pump efficiency and its relation to mine power-costs is shown in chart form. It will be gladly sent on request.

Ask for the "No Waster's Penalty" Folder

The Aldrich Pump Company

No. 7 Gordon St., Allentown, Pa.

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"Ruggles-Coles" Dryers

They run for years without breakdown

For more than 27 years we have consistently worked to produce dryers that operators could learn to depend upon for steady, uninterrupted service. From the beginning, our policy has always been to employ only the highest class of workmanship and the best materials in building our dryers.

All plates, tires, gears, wheels and castings entering into the construction of Ruggles-Coles Dryers are the best to be obtained. There are no weak parts to be easily broken.

The unusual strength and ruggedness of Ruggles-Coles Dryers permits them to operate 24 hours day after day with minimum wear. In fact, some of our machines have consistently been on the job for 20 years.

Our catalog will give complete information regarding construction and operation of all Ruggles-Coles Dryers.

RUGGLES-COLES ENGINEERING COMPANY

120 Broadway - New York City

You Need This Book

DU PONT *"Blasting Accessories"*

Mail the Coupon Today

IT contains up-to-the-minute details covering the most advanced blasting practice, which will prove valuable to anyone engaged in the purchase or use of explosives.

Du Pont Blasting Accessories are designed by the world's largest makers of explosives to give completely satisfactory results under all conditions. They are the most widely used of any accessories made, simply because they deliver 100 per cent service.

Blasting Caps	Galvanometers
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Gentlemen:

Please send me your book "Blasting Accessories," without charge or obligation to me.

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PRESCOTT MENOMINEE

23rd Level, Pabst Shaft
Ironwood, Michigan

Station Pumps in the Pabst Shaft

THERE'S no shambling or relaying of water with Prescott-Menominee Pumps and this installation in the Pabst Shaft of the Oliver Iron Mining Co., Ironwood, Michigan, is no exception.

Here each, for there are two, $4\frac{7}{8}''$ x $24''$ electrically driven Prescott-Menominee Pumps is delivering, direct to the surface, 400 gallons per minute and working against a 1700 foot head.

400 Gallons per Minute

Head 1700 ft.

We specialize in Electric Pumps for deep mines and would welcome an opportunity to discuss your pumping problems with you.

THE PRESCOTT COMPANY

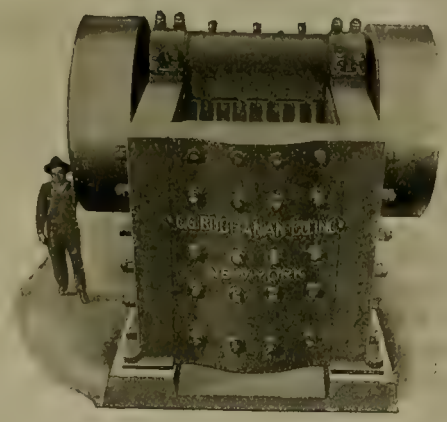
FRED. M. PRESCOTT, President

Menominee, Michigan

Buchanan
Crushers and Rolls

In Stock for Immediate Shipment

Simple — Strong — Durable



Type "C" Jaw Crusher

Illustration shows Buchanan 'All-Steel' Jaw Crusher, with frame of 'box' construction, intended for heavy and continuous duty encountered in mining operations.

Jaw plates are made sectional. Upper and lower plates are inter-changeable, increasing wear obtainable.

Steel-castings are carefully annealed and all shrinkage strains are entirely removed. Bearings have double system of lubrication, are water jacketed, and in the larger sizes are removable.

Built in sizes from 24" x 36" to 66" x 84".

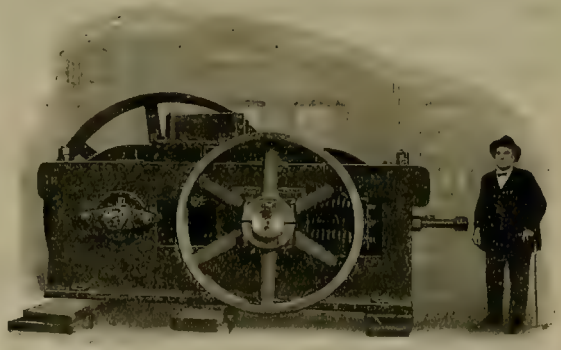
Write for Bulletin No. 10

Type "C" Crushing Rolls

Built in all sizes and types from 18" x 12" up to and including 72" x 30".

Buchanan Crushing Rolls are furnished with rolled chrome-steel shells, phosphor bronze bearings, fleeting device for preventing grooving of the shells, patent swivel pillow blocks, and every known improvement of value, to date.

Write for Bulletin No. 13



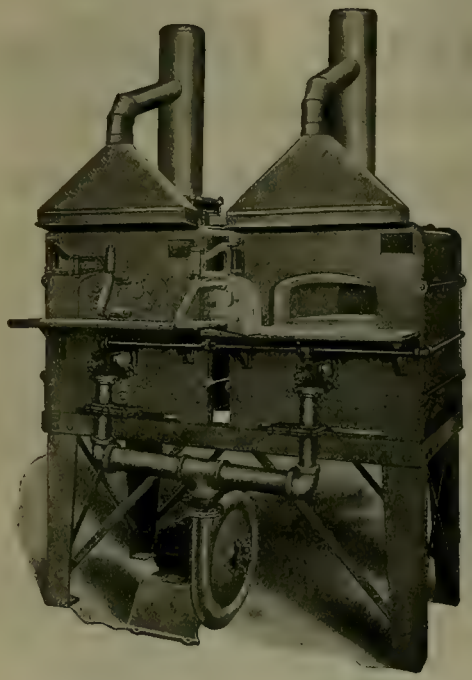
C. G. Buchanan Co., Inc.
West and Cedar St., New York

Western Representative:

W. H. Moore Jr., Trustee for COLLINS & WEBB, Inc.
314 East Third St., Los Angeles, Cal.

BUCHANAN JAW CRUSHERS
ALL STEEL PATENTED

After twenty months of service—



D. F. C. TWO MUFFLE OIL FIRED FURNACE

What a large metallurgical company wrote us April 19, 1921:

Gentlemen:

We unhesitatingly recommend the DFC Oil Fired Assay Furnace.

A two muffle furnace, which was in place when we took over the laboratory, has been operated by us for a period of twenty months. During this time the only repairs necessary were two muffles—the last being still in place and probably good for two months more use.

The oil consumption is very reasonable. We have kept no accurate record, but the consumption is probably about two gallons of fuel oil per hour.

No trouble is experienced in feathering cupels or in controlling the temperature at any time.

Yours very truly,
THE A. H. JONES COMPANY
(Signed) A. H. JONES.

A record to be proud of:

"Unhesitatingly recommend" . . . . "Only repairs necessary were two muffles—the last being still in place" . . . . "Oil consumption is reasonable" . . . . "No trouble in feathering cupels or controlling temperature."

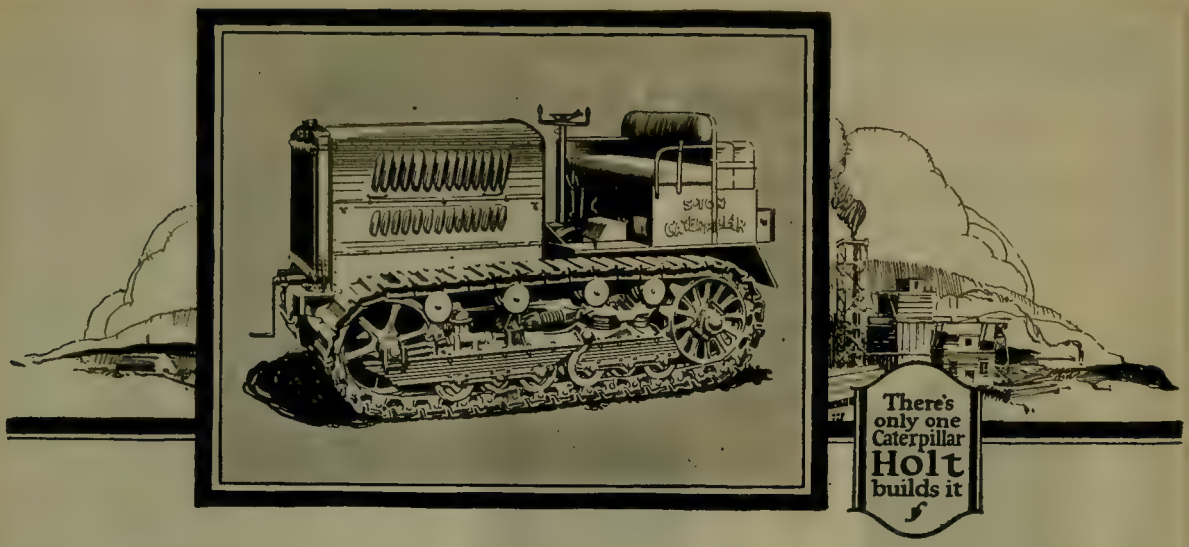
A FURNACE FOR EVERY NEED

Send for Bulletin 425

THE DENVER FIRE CLAY COMPANY

Salt Lake City DFC New York City

DENVER, COLORADO, U. S. A.



"Caterpillar" Power is Flexible and Economical

In erection of mine buildings, structures, head frames, ore bins—in hauling timbers, ore wagons, supplies the flexible, economical "Caterpillar" 5-Ton Tractor (with or without winch attachment) is the handiest form of power.

Liberal surplus over rated power, lowest cost per working hour, long life because of accurate standards of construction—all of these plus "Caterpillar" adaptability and dependability make it one of the most useful pieces of machinery in mine work.

Where greater power is required the "Caterpillar" 45, the "Caterpillar" 10-Ton and "Caterpillar" 75 supply it abundantly. The last is by far the most powerful tractor on the market today.

Send right now for complete information about "Caterpillar" Tractors.

THE HOLT STATIONARY POWER UNIT

It is built right in the Holt shops from the casting of cylinders to final inspection—built to exceptionally exacting standards of design and construction. This engine is doing heavy duty in every kind of service.

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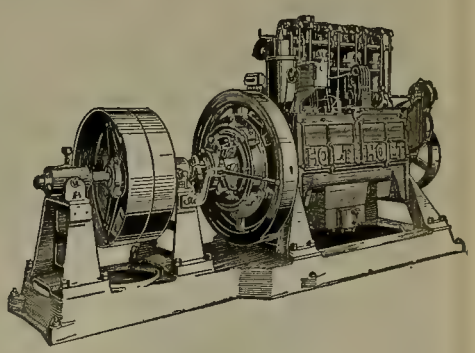

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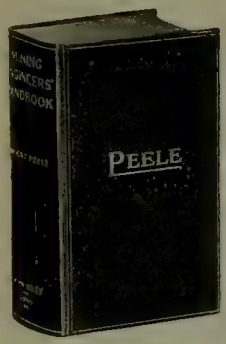

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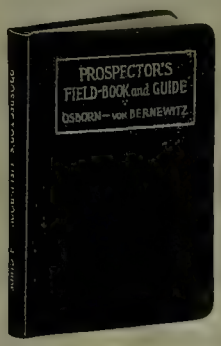

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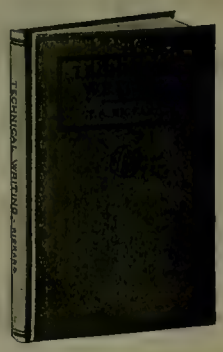

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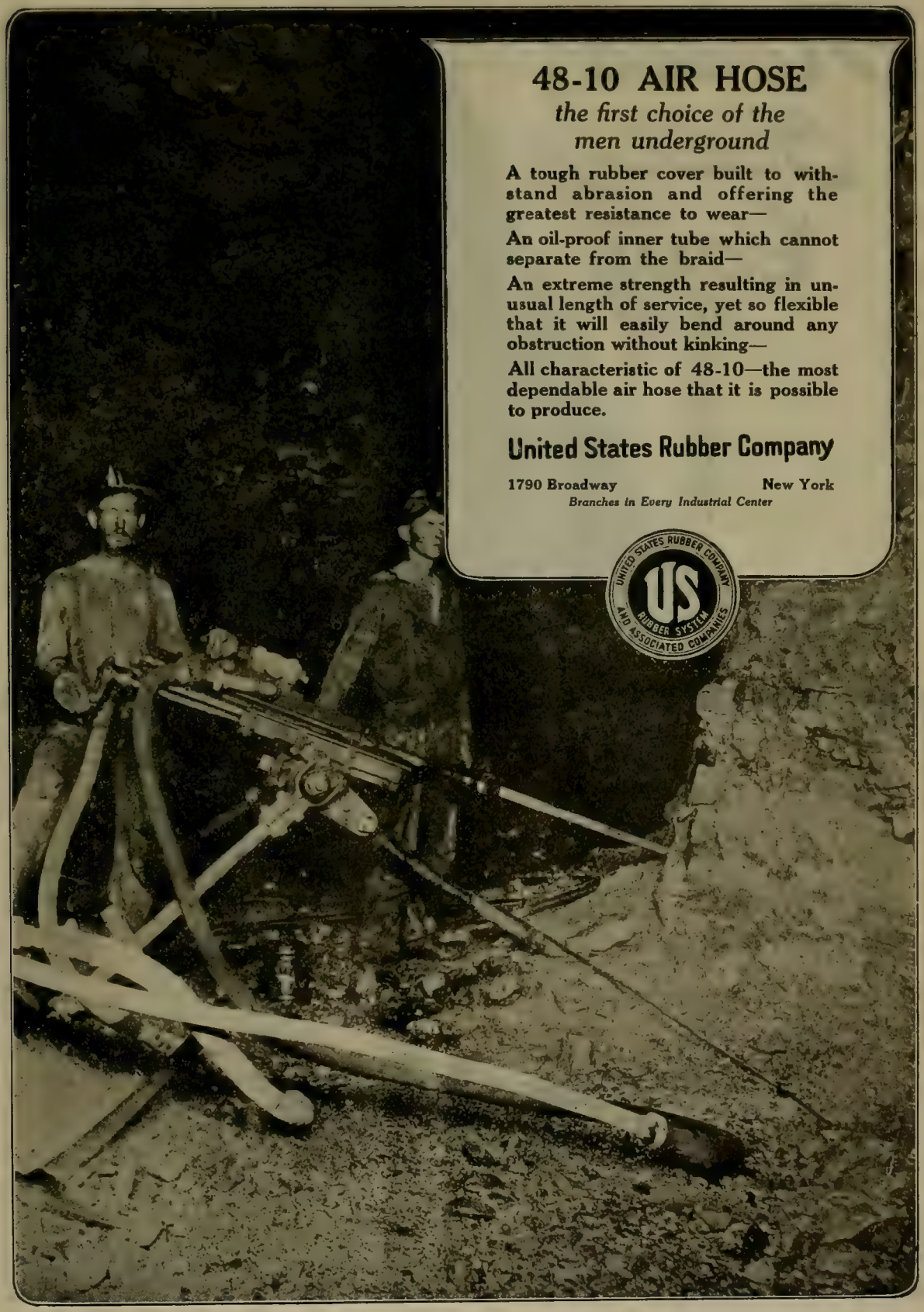
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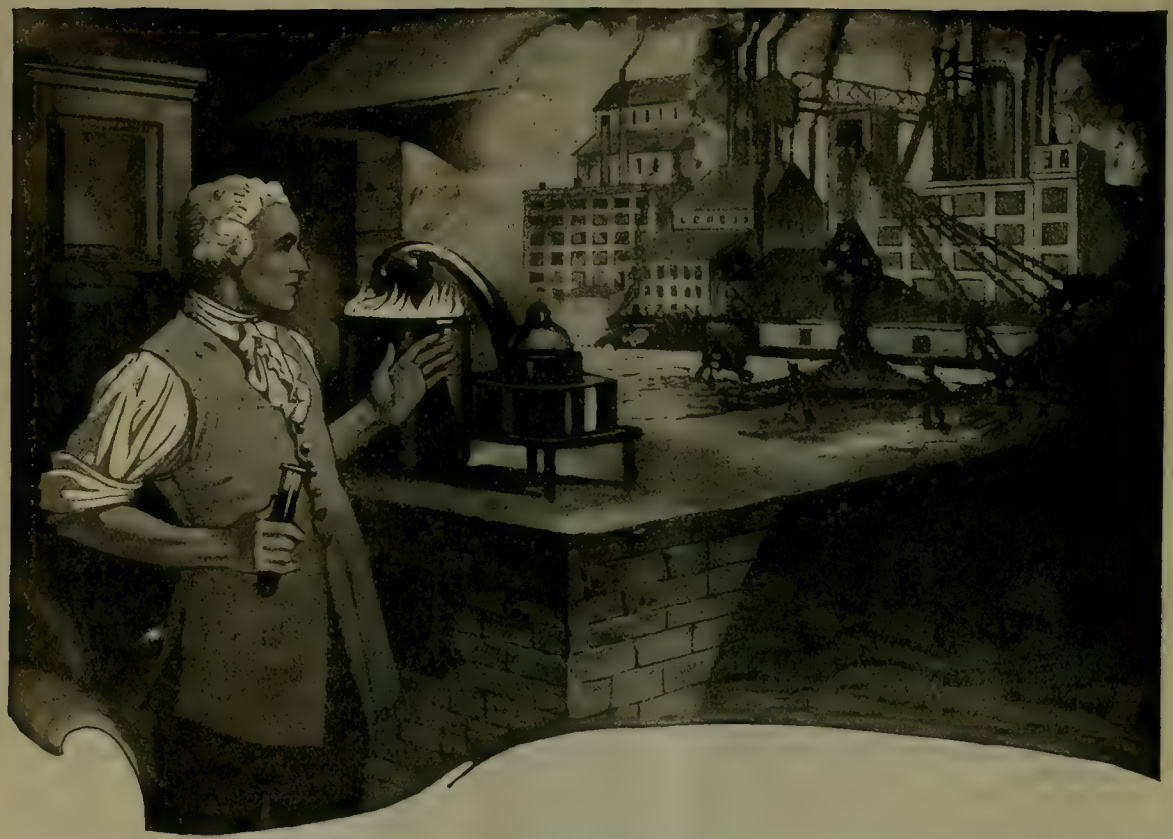

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T. A. RICKARD, - - - - Editor

MEXICO is always a subject of immediate interest to the mining engineer. Therefore we take pleasure in publishing the scholarly article by Mr. Robert G. Cleland that appears in this issue. Mr. Cleland reviews the history of Mexico in relation to the development of its mining industry, describing the methods established during the period of Spanish dominion. For the beautiful photographs on the four-page insert we are indebted to Mr. Frank H. Probert, Dean of the Mining College in the University of California.

DISRAELI said that there were three kinds of lies: "lies, damned lies, and statistics". We are reminded of this saying by the discrepancy between various statistics purporting to give the number of Japanese in California. As the subject is controversial, it is inevitable that the statistics should be also. In discussing the subject of Japanese immigration in our issue of October 16, 1920, we quoted, with a reservation, the statement of the State Board of Control, in California, that there were 87,279 Japanese in this State at the end of 1919. Now comes the U. S. Census and says that the number in 1920 was 71,592, as against 41,356 in 1910, an increase of 42%, as compared with the gain, within the same period, of 44% in the total population of California. Hearst says that 38,000 Japanese failed to register; he is probably wrong, but the fact remains that the people of California question the correctness of the Census figures. It would be well to confirm them officially.

LEGITIMATE journalism is hard to kill. On June 1 practically all the compositors, pressmen, and bindery workers at the plant of our contemporary, the 'Canadian Engineer', at Toronto, went on strike for a 36% increase in wages, with a reduction in working hours from 48 to 44 per week. The strike for a shorter working week was ordered from Union headquarters at Indianapolis, Indiana. Canadian workmen obeyed the order, and demanded more pay and less work at a time when the country was expecting a reduction in the cost of labor. The publishers could not meet the demand without advancing subscription and advertising rates, so they joined forces with others in Toronto in resisting the Union. Realizing that the strike might last for several weeks, the publishers of the 'Engineer' are now producing their magazine in newspaper form; and from the first issue in the new style we have obtained the foregoing news item. The moral support of the community is behind them in their resistance to unionized tyranny. We commend our contemporary across the border for the plucky fight against international interference and dictation, and for its resourcefulness in producing the 'Engineer' as a newspaper under present conditions.

GENERAL satisfaction will be felt among members of the Institute when they learn that Mr. Frederick F. Sharpless was selected unanimously by the directors on June 24 as Secretary, in succession to Mr. Bradley Stoughton, who resigned recently. Mr. Sharpless is a native of Pennsylvania and 55 years of age; he is a graduate of the University of Michigan, and for five years (1888-1893) he was Professor of Metallurgy in the Michigan College of Mines. Subsequently he practised as a consulting engineer, and was connected professionally with several important mines in the West, notably in California. He has traveled extensively abroad as well as in his own country, and enjoys a wide acquaintance among those engaged in mining. Besides his honorable prominence in the profession and his extensive knowledge of mining affairs, he is peculiarly fitted for his new appointment by reason of having served for several years, and until now, as secretary of the Mining and Metallurgical Society of America. One effect of his appointment therefore should be to foster the most friendly relations between the Institute and the Society, and thereby to further an eventual consolidation of these two organizations. Mr. Sharpless is a Quaker, that is, he belongs to the Society of Friends; we feel sure that to him the Institute will be another society of friends, and that his record as Secretary of the Institute will be honorable and successful.

SLACKNESS is an argument that does not appeal to the average Britisher, said Mr. Thomas W. Lamont in an address at Union College, Albany, recently; and for this reason the miners, in their strike appeal to public opinion in England, have lost support. Between the miners and the operators there have been the same age-old questions as to working hours and wages that we have had in our own coal regions. The men have had good

cause for complaint in Great Britain; they faced the hardships of a reduction in wages that was heavier than the lowered cost of living. Their one great and irretrievable point of weakness was their reduced output. Figures furnished to Mr. Lamont when he was in England recently showed that the output per man shift in 1920 was nearly 30% less than it was in 1913. This policy of reduced production is condemned by Mr. J. R. Clynes, the British labor leader, in a recent issue of 'Imperial Commerce'. He draws attention to the fact that toward the end of last year, which was a time of low production in Great Britain, the highest figures of unemployment were recorded. Wage earners still clung to the belief that increased output merely adds to the gains of the capitalist class. This idea must be controverted, and no change in the attitude of the worker toward the problem of production can be anticipated until the men are safeguarded against unemployment, and until proof is given that additional output is not of greater benefit to employers than to the operative classes. The conclusions of Mr. Clynes, as coming from a Labor leader, are worthy of serious attention in this country as well as in Great Britain. Greater output, he says, would confer more benefit upon wage earners than upon any other class of the community, whereas decreased production increases the burdens of the worker and diminishes the purchasing power of his wages.

IN his address to the students at the Colorado School of Mines, which we reproduce in this issue, Mr. Frederick Laist made a number of pertinent suggestions that are worthy of a wider audience. *Inter alia,* he drew attention to the important fact that the failure of large-scale operations, when blamed on the assumption that the results of laboratory tests did not materialize, is too often due to the circumstance that the preliminary work was planned and executed improperly. The tendency, as the manager of the Anaconda reduction works remarks, is to allow the wish to be father to the thought; the laboratory work is done under conditions that could not possibly be duplicated in practice. This is particularly true in connection with the wet metallurgy of gold and silver. Since the beginnings of cyanidation, the most absurd methods of anticipating the results of practical operation have been in vogue. A common laboratory test is to agitate the ore with cyanide solution in a stoppered bottle; the ore is then washed with an indefinite amount of water, the amount of gold in the residue being taken as an index of what may be expected if cyanidation be adopted. Another common plan is to subject the pulp of ore and cyanide solution to prolonged action in a model pebble-mill, under conditions that it would be impossible to duplicate in practice. Tests are too often made with solutions of pure water and cyanide, instead of with those that carry the normal amount of impurities found in the liquor that circulates in a cyanide plant. The consumption of cyanide is often estimated incorrectly and by means of a difference of cyanide content before and after a bottle-test in which clean water has been used to prepare the solution, instead of working liquor; the exposure of immense areas of solution, the effect of violent agitation in the presence of excess of air, and the consumption of the cyanide that is used in dissolving a precipitant are seldom anticipated. And so it is that when results on a working scale do not approach the estimates of extraction, the excuse is made that laboratory tests seldom agree with full-scale operation; and another blow is dealt at scientific research.

WE refer elsewhere to the amenities of 'discussion'. In this issue there appears a short note, from Mr. S. H. Raine, that calls for further comment, because otherwise it might leave an impression that we accept his friendly jibe that the criticism of 'experts' in apex suits is the "favorite indoor sport" of our editorial staff. On the contrary, we are engaged in serious work and not the least is an effort to bring about reform in the methods of mining litigation. The editorial opinion of the decision in the Tom Reed v. United Eastern case appeared in our issue of May 14. Our Mr. Parsons wrote an article that was partly in disagreement with that editorial, and it was interesting for that reason among others. Our policy is to encourage the ventilation of individual views on controversial subjects. Mr. Raine admits that "the law is inadequate", then let him bring forward a helpful suggestion, as we have, more than once. The article by Mr. Parsons has been justified not only by its intrinsic merit but by the fact that it has elicited a courteous and useful rejoinder from Mr. Burch. Mr. Raine concludes his note by suggesting that we give "the subject a rest" unless we can "suggest a practical remedy". We refer him to our issue of May 14 and May 28 of this year. In the latter we refer to Mr. D. W. Brunton's suggestion, as in our issue of August 28, 1920, we discuss the matter apropos of the interview with Mr. Burch. Our issue of April 24, 1920, contains an editorial on 'Geologists in the Courts', and in it we make sundry proposals. When Mr. Raine has read these we shall be glad to hear from him again, for we feel assured that he can help forward the purpose in hand.

Discussion

The pages set aside for 'discussion' constitute an important part of the 'Mining and Scientific Press'. We can readily suppose that, to many, it is the most interesting portion of our paper. In the first place, the average man likes to get the views of various people instead of the opinions of one person, such as the Editor. To a member of the congregation there is something piquant in the sight of one in a neighboring pew arising to controvert the minister in the pulpit—not that we suggest a close simile, for we editors claim no heaven-sent mandate, much less a celestial inspiration for our sayings. In any event, the average reader is given the editorial views on current topics so frequently that he can almost anticipate the stand that may be taken on a given subject, whereas the opinions of his fellow-readers have a variety and

vagrancy that gives them the charm of the unexpected. Frankly, the editor finds them interesting and is glad to have them, especially if they express disagreement in a form permitting of publication. We receive numerous letters of approval and endorsement, of course, but we rarely publish such letters because they are not interesting to other readers; they are like the recommendation brought by the office-boy from his mother, they are interesting only to the family. On the other hand, when a reader objects to some editorial utterance, and gives reasons for his objection, we know that such a letter will be read with keen interest, because, among other reasons, the average engineer, whom we suppose now and always to be an intensely human and altogether intelligent person, likes to see a 'kick' recorded and to feel that thus he also is represented in the forum of public opinion. However, there is an even better reason for placing a high value on the 'Discussion' columns: they enlist the assistance of the busy men, usually the very ones whose ideas are most dynamic. For example, in this issue the subject of 'Valuing Partly Exhausted Mines' is discussed by Mr. Milnor Roberts, Dean of the School of Mines in the University of Washington, and one of the leading mining engineers of the Pacific Coast. 'The Rehabilitation of the Russian Mining Industry' is the subject of a timely letter from Mr. T. J. Jones, a Californian engineer prominently connected with the Kyshtim and other important copper-mining enterprises in Siberia. Mr. Albert Burch, who needs no description, contributes a criticism of the article by Mr. A. B. Parsons on 'Mining Litigation and Common Sense', making a useful suggestion for improving the method for trying apex suits. Our friend and former associate editor, Mr. F. H. Mason, sends a note on the 'Coloring of Glass', in reply to the recent letter on this subject from Mr. Francis Drake. It will be acknowledged that discussion on such subjects by men so well qualified is an honor to technical journalism, and we accept it as such. Recently the volume of discussion has been unusually large, and we hope it may continue to maintain a vigorous amplitude, as well as good quality. We take an opportunity of thanking our friends the prospectors for their response to our invitation to 'chip in'. In a measure it is the duty of members of the profession to contribute corrections or confirmations of important statements on technical subjects in which they are versed—and more particularly corrections, for an error is hard to overtake if it gets a good start. The editors, of course, keep a watchful eye on unintentional blunders appearing in the text of the manuscripts sent to them, but such errors are of less importance than the larger ones of fact or inference that are inevitably present occasionally in a large mass of technical writing. Criticism, frank and fair, is the very life of technical journalism, particularly of the kind devoted to the interests of a specific profession; therefore we welcome contributors to 'Discussion', especially when they find reason to disagree with the Editor or his associates. In these days of deflation and depression, when mining affairs are moving at a rate that musicians describe as *piano*, but not *pianissimo*, it may be that some of our friends have time to sit down and read with more than customary deliberation. This is a good time for revising current theories and accepted ideas, as well as for incubating new ones. Gentlemen of the profession, we shall be glad to hear from you.

Influence of Metallurgic Methods on Gold Production

In these days of declining gold production it is interesting to review the metallurgic methods in vogue at the premier gold-producing centre of the world, in accounting for the tenacity with which Johannesburg has retained the lead for so many years. Conditions have been favorable, the deposits are large, and are distributed in a manner favorable to centralized control. Another important influence is seen in the advantages that accrue from friendly rivalry between the staffs of a large number of companies, all of which are working in the same district and on ore of practically the same character. No disguise of technical results is possible; operating expenses are reduced to a low level; metallurgic losses are compared, with much gain to all concerned. Furthermore, the statements of results conform to a uniform plan that aids comparison and gives the information in a direct and straightforward manner. The statistics in the annual reports permit an accurate accounting of the results at various phases of the metallurgic operations; the final estimate is made on the basis of the yield of gold, as well as upon a comparison of assays—a practice that in many cases proves, incidentally, the accuracy of the sampling and assaying methods in vogue. It is unfortunate that the reports of operations at some of the important reduction works in this country show no uniformity of presentation; in many cases it is no easy matter to determine the actual outcome of the work or to make comparison of the efficiencies of different processes. This is due largely to the custom of reporting the metal contents of ore, of intermediate products, of tailings, and of residues in terms of the national currency. In South Africa all the companies use the pennyweight (dwt.) and decimal fractions as the unit of gold content; here, the troy ounce has been adopted for use in all statistics relating to gold and silver bullion, but the dollar is frequently taken to represent the *amount* of gold and silver in the material under consideration. In attempting to justify the practice of confusing currency units with weight of metal we are accustomed to refer to the 'assay-value' of an ore. A statement to the effect that a gold ore has an 'assay-value' or even a 'value' of $1 is an example of current phraseology that is lamentably deficient in logical justification. However, the custom is deep-rooted, and its persistence appears to be inevitable. The disadvantage is that in many instances this method of appraisal fails to give the information desired. A residue sometimes contains a proportion of silver in economic amount sufficient to warrant calculation, and the 'value' is estimated on the basis of the average price

received for silver throughout the year. The selling price of silver has varied considerably in the recent past; it will doubtless fluctuate in the near future. Whether the selling price of gold will also vary will depend on governmental action or inaction. Suffice to say that at some future date, when the re-treatment of what are now considered as valueless residues is being considered, some additional calculating will be necessary—if no more information is available than the 'assay-value' in terms of dollar currency—to determine the metal content of the dumps or other rejects from former operations.

The recording of metallurgic results in terms of troy weight makes it easy to review, with added interest, the economics of the Rand. At the Witwatersrand Gold Mining Company's plant, for example, we learn from the annual report that 416,200 tons of ore was treated during the past year. This was reduced by stamps and tube-mills to a size suitable for amalgamation and cyanidation. The gold in the original ore (as determined by amalgamation yield plus the gold-content of the resultant tailing) was 5.807 dwt.; after amalgamation it assayed 1.597 dwt. The sand, representing about 60% of the tonnage, was then leached; it carried 2.099 dwt. before treatment and 0.333 dwt. afterward. The slime, treated by the usual method adopted on the Rand, contained 1.118 dwt. before treatment, and 0.183 dwt. afterward. Such a concise statement of metallurgic results renders it easy to re-calculate the figures in terms of percentages, and to visualize the minute amount of precious metal present, in proportion to the quantity of valueless material, both before and after treatment. It is then found that the ore entering the plant contains less than one-thousandth of 1% of gold; when discharged, the average residue contains less than one-half of one ten-thousandth of 1%—0.000046%. These figures convey some idea of the amazing success of the cyanide process when operated on a scientific basis; they compel attention to points of economic and metallurgic detail that, in view of the general decline of gold production, should be accorded careful study. The first important fact is the comparative poverty of the ore. Economical treatment is essential; all-sliming is avoided, the total milling, amalgamating, and tube-milling costs amounting to 2.676 shillings per ton, which is about 53 cents at the present rate of exchange, and considerably less than when crushing and grinding to a slime are practised. Amalgamation plays an important part in the scheme of treatment on the Rand, about 72% of the total gold in the ore being recovered by this method at the Witwatersrand mill. The ratio of stamps to tube-mills (215:4) in this particular instance is also noteworthy, as indicating a tendency to retain, so far as possible, the fundamentals of the early practice of plain stamping and amalgamation.

The pulp after amalgamation is exceptionally low-grade (1.597 dwt. per ton). Conditions are highly favorable for the production of a low average residue (0.269 dwt.) after cyanidation. The pulp is classified, the major proportion of the sand being leached by the gravity method. Two features may be emphasized: the comparative fineness of the grains that comprise the charge—it is not usually realized that an exceedingly fine but slime-free sand can be leached successfully—and the homogeneity of the mass. Leaching is a cheap and simple process; a large volume of ore, as sand, can be impoverished of its gold at little expense above that incurred by the operation of a pump and the consumption of chemicals. The metallurgic efficiency of leaching has been amply demonstrated in connection with copper practice as well as in the treatment of gold ores. Another important factor is that the loss in dissolved metal (so far as can be ascertained, and assuming that all the undissolved gold in the residue has avoided dissolution and re-precipitation) is more or less in proportion to the grade of the solution in contact with the ore when displacement, with weaker solution or water, is commenced. After efficient amalgamation in the plants of the Rand, the pulp, as well as the resultant cyanide solution, is low-grade; the dissolved loss, therefore, is small, often negligible. The major loss is in the form of undissolved gold, against which must be credited the saving in the cost of grinding, to produce a maximum of fine sand rather than a maximum of slime. In the case of the Witwatersrand company's operations, the total loss of gold per ton in the residue of classified slime is no more than the dissolved-gold loss per ton in the total residue of the United Eastern plant in Arizona, where all the ore is reduced to a slime, where the pulp contains a large proportion of crystalline grains, but where preliminary amalgamation, apparently, is impracticable, or was disregarded in the original plan, for economic reasons. No actual comparison is possible, of course, but the advantages to be gained, wherever practicable, by impoverishing the ore by amalgamation and before cyanidation appear to be obvious. Thanks to the recognition of this important metallurgic principle, the Homestake mine continues to treat, with considerable success, an exceptionally low-grade ore, and aids in maintaining the remarkably uniform production of gold from South Dakota, in contrast to the decline that has occurred in practically all the other States of the Union. The work at the Alaska Juneau property, in Alaska, is another indication that initiative, confidence, large-scale operation, and a realization of economic conditions are the fundamentals that will ensure an increased production of the precious metal in this country, and from the low-grade deposits. In considering a scheme for the treatment of gold ore, due consideration should be paid to a process that will make a financial success of the beneficiation of ore of the lowest average that can be mined; selective mining is expensive—it costs gold; the rejection of low-grade ore results in waste of gold. The subject is one of vital national concern at the present time. In view of the economic and metallurgic success that has attended large-scale leaching and concentrating operations during recent years, a new departure may be made when similar methods are applied more generally to the treatment of low-grade deposits of gold ore in the United States.

Assessment Work

The Editor:

Sir—We hope you will use every means to kill the bill recently introduced in Congress by Senator Bursum of New Mexico. For the sake of a languishing industry, for the prospector, miner, millman, and mining engineer this bill should not be allowed to pass. Through our Institute, through other societies, and through Mr. Hoover we desire to voice our protest.

Nayarit, Mexico, June 2. ALGERNON DEL MAR, CHARLES V. CRAIG.

Valuing Partly Exhausted Mines

The Editor:

Sir—The recent articles by Mr. Morton Webber on this subject, together with the editorial comments on them, are very interesting both on account of the valuable information they contain in clear and emphatic form and also because they bring forward the importance of the human element in mine valuation. The subject is one that cannot be reduced to formulas nor proved in every particular. In spite of man's best technical efforts he remains in the dark as to what might have been found by deepening mines that apparently failed at certain levels, but this fact need not deter us from establishing principles for mine valuation. Already devices are being tried that may yield information regarding ground beyond the workings.

To secure full and reliable information concerning an old or idle mine is often a hard task, as Mr. Webber points out. The difficulty of obtaining the general facts regarding former operations is in part unavoidable, since it is inherent in the nature of mining, especially that which has taken place in distant localities. As to records, omissions of the past cannot be helped, but we can at least combat the tendency to discard anything and everything that savors of the past. The way can be smoothed for the coming generation, and perhaps for ourselves in later years by keeping more thorough maps, sections, accounts, and statistics and also by making the mine show its own historical record in the form of specimens. A collection made as the mine develops can be made to show typical examples of the wall-rocks and the ores in their various phases and modifications from the outcrop to depth. Such a collection is always convenient for reference and some day it may prove invaluable. Too often an interesting piece of ore that might yield an important clue to an expert finds its way to the curio cabinet of some stockholder rather than to a well-arranged working collection at the mine. A visiting engineer has enough to do when examining a property as a whole and studying its most vital parts without having to make a search of the surface and the old workings for type specimens of the ores of bygone days.

The plan of dividing proposed expenditures for development into stages, with an estimate of the cost of each step, appeals to engineers and to men experienced in promoting or backing mining operations, but does not always strike the fancy of the investing public, which needs constant education on this point. Many investors if told that they might have to wave good-bye to their first stake in a certain mine, and worse still their second, would lose interest in the scheme before it started. At the convention held in Vancouver, B. C., in 1919, Mr. Rickard in his address* pointed out clearly that the history of mining shows it to have been an adventure for capital rather than an investment.

An additional cause may be mentioned that has accounted for the closing of some mines in the rugged regions of the North-West, especially in the early stages of mining. It applies to properties situated in distant localities where transportation is difficult or costly, and the case may be summarized as one in which a mine rises and falls with a district. Such a mine will bear watching. To illustrate: An out-of-the-way camp may have a period of prosperity covering a few seasons when roads are in order, a public transportation system is operating, supplies are available, general stores are open, men are on hand, and conditions in general are easy. Sooner or later the weaker prospects fade out, the drifting population leaves the camp, and work is concentrated on one or two claims, resulting perhaps in a going mine. But the common carrier when dependent upon a mere handful of people fails to meet expenses and ceases to operate. A hard winter comes along and the 'Lone Hand' mine is forced to shut down, temporarily it is hoped. But when the snow has gone, the road is found to be greatly damaged. The mine-owners hesitate to risk the whole burden of opening the camp, and a likely mine remains idle. In later years another period of interest in the district, called by one old prospector a 'spasm', may permit the fortunes of the Lone Hand to rise with the general prosperity of the camp.

An entirely new chapter may be suggested with the title, 'Examining Mines Partly Exhausted by Nature', referring to operations in deposits that have been partly removed by erosion. This case is common in many north-

*'M. & S. P.', April 19, 1919. 'Mining: An Investment, a Speculation, or a Gamble?'

ern regions and in the high altitudes, especially in glaciated areas. Although the condition is due to geologic forces rather than to past mining, the result is so nearly the same and the case contains so much of human interest that it deserves a place in the discussion. The fact that an ore deposit was formed at a depth of thousands of feet below the surface then existing, and that the overlying rock has since been eroded, leaving the ore exposed at the present surface, seems to many persons connected with mining to be a difficult idea to absorb. The small proportion of such cases that the average engineer is called upon to examine, and the lack of general realization of the great speed with which glaciers and debris-laden streams perform erosion, partly account for the failure to recognize the condition described, but, whatever the reasons, the fact remains that it commonly receives little attention.

In the Pacific North-West and in the mountains northward through British Columbia and Alaska are found many orebodies exposed at the present surface in canyons and on valley-walls, yet bearing every mark of origin at moderate or great depths. Sulphides at the actual surface are not uncommon. Here Nature has done a vast amount of preparatory work for the prospector by removing thousands of feet of rock-covering from an ore deposit. She may even have done preliminary development and cut into the upper portions and outer edges of the mineralized area, which is most fortunate for man. Often, however, erosion has progressed to a stage corresponding to the working out of the upper levels of a mine, for the upper portion of the deposit and the country-rock enclosing it have been wholly removed, leaving the orebody exposed at its heart. In this case the mine-dump, that useful indicator mentioned by Mr. Webber, is rarely present in such amount as to be a gauge of quantity removed, although qualitative evidence is found in such forms as placer gold occurring in gulches where it has accumulated from veins in the adjacent hills, or as float lying in the talus and moraines of glaciers.

Now as to the mine-valuer's interest in the case: When he inspects a prospect showing unaltered chalcopyrite at the outcrop of a vein occurring in a granite batholith at the foot of a canyon-wall, with granite cliffs towering above for thousands of feet, the total lack of an oxidized zone in the vein is evident. But on a developed mine in a corresponding situation the unusual nature of the surficial ore may be less noticeable, especially if, as often happens, the mine is opened by an adit started at a convenient point, while the outcrop occurs on some almost inaccessible cliff, or is covered by a snowbank, or is worked out. The attention of the men on the ground is centred on the lower workings, without thought of the history of the mine's early development. The fact that the wide and strong outcrop showed sulphides glistening under the blue sky is forgotten, or its significance has become dimmed. The position of the present workings with reference to the outlines of the ore deposit as it was originally formed, is not emphasized, and is commonly overlooked, with the result, to summarize briefly, that the orebody is assumed to have an average chance of depth below its present outcrop, whereas the outcrop in a typical case really exposes the orebody at its heart.

Seattle, Washington, June 14. MILNOR ROBERTS.

Rehabilitation of the Russian Mining Industry

The Editor:

Sir—Many articles have appeared in the public press recently, most of them doubtless from inspired sources, but all foreshadowing some kind of political change that might bring about a condition favoring the safe employment of foreign capital for the resuscitation of industry and the profitable development of the vast resources of Russia. It seems as if the present so-called government has at last realized that there is no way out of its difficulties other than by a return to old-fashioned co-operation between capital, brains, and man-power. Lenin and his associates are grasping around in the darkness of their world isolation for some practical method of bringing this about. This, of course, is a political question, and it is not my purpose to discuss how it will be accomplished except to express the opinion that definite action may be anticipated, and that soon it will be possible to regard Russia as the greatest field for industrial and mining development the world has ever known.

There is a general impression abroad that so much destruction has been wrought and the economic life of the country dislocated so completely that a return to pre-war conditions must, even under the most favorable auspices, require a very long time for its consummation. I have heard men say that it would take twenty years to restore business and industry, after all existing barriers were removed. There is also a general impression that Russia in pre-war days was, on account of great distances, lack of rapid transport, rigors of climate, and the lassitude of its people, a slow and tedious country in which to work. Any engineer who has had the supervision of mining or industrial development in Russia will, I think, bear me out in the statement that both these impressions are erroneous. All sources of information agree that the destruction of property, especially of industrial plants, has been small. It is well known that, though some of the industrial centres have changed hands many times during the past four years of civil strife, the mills and factories are still standing. They suffer only from lack of usage and repair. The condition of the railways, so far as trackage, bridges, and other fixed property are concerned, is reported, by American engineers who have traveled over them within the past year, to be good. Russia and Siberia, with an area approximately four times that of the United States, has less than one-fifth as many miles of railway; but it has a far greater mileage of navigable rivers upon which traffic could quickly regain its former importance. The steamers and barges were all built in Russia, and from domestic material.

Outside the great centres of population the economic

life of the people has more or less adapted itself to existing circumstances. In many districts a general revival of the ancient home industries has provided linen and woolen cloth, leather, felt, and other necessaries. There is a general reversion to the primitive life of a hundred years ago. The desire for commodities of modern life, however, and the willingness to work for them if opportunity were afforded still remain. It is certain that the mass of the people is ready and anxious for the employment that would enable them to live as they did before the War.

No difficulty would arise and no time would be lost in the rehabilitation of industry on account of labor. In all of the building trades, the Russian workmen were highly skillful. Their slow and primitive methods made it necessary to employ larger numbers than is usual in this country, but remarkably rapid progress on all kinds of construction work was the rule. Large operations in Russia were generally much more self-contained and independent in the way of facilities for construction and repair than in almost any other country. A copper mine, for instance, had its own foundry and machine-shops, where not only repairs of every kind were done, but where a large part of the mechanical equipment was designed and built. Special alloys of steel were made. Electrical equipment of all kinds, including generators, motors, and transformers, were built on the property. Structural steel such as is needed for head-frames, buildings, and traveling cranes were fabricated from sections that were rolled in the district. The Russian staff included some of the best mechanical and electrical engineers to be found anywhere; there were artisans of every kind, with a skill and pride in their work comparable to that of any country. The great majority of these people are still in the country and would be available.

Generally speaking, the only arguments for the success of industry in Russia were, and again will be, capital and organizing talent. The Russians of the intelligent class were capable and brilliant in many respects, but inherently weak in the matter of organizing ability. Foreign companies commenced their operations with specialized heads of departments from abroad, but usually found that in a year or two these could be dispensed with, without detriment to the business. The situation in Russia is, of course, bad, but it is far from hopeless; estimates of the time that would be required for the resuscitation of industrial activity can easily be exaggerated.

London, May 20. T. J. Jones.

Mining Litigation and Common Sense

The Editor:

Sir—Mr. Parsons, in his discussion on 'Mining Litigation and Common Sense', indulges in the favorite indoor sport of the editorial staff of your journal.

No good purpose is served, so far as I can see, in criticizing the geologists and engineers who appear as expert witnesses. *They did not make the Law.* As a matter of fact, they all agree that the law is inadequate; that the system is wrong; that it does not, and cannot, cover situations which have arisen in the past or which will arise in the future.

I have observed that a mining company, unfortunate enough to have an apex suit on its hands, seems to be perfectly willing to retain the best talent in the country to help it out of its difficulty. This is really good business on the part of said mining company.

If you are unable to suggest a practical remedy for the law itself don't you think it would be good sportsmanship to give this subject a rest?

Butte, Montana, June 13. S. H. Raine.

The Editor:

Sir—The article by Mr. Arthur B. Parsons in your issue of June 11 shows the results of much study and thought by an amateur. He starts with an assumed premise that decisions in mining cases should be based upon common sense, whereas the fact is that such decisions must be based upon the law and the evidence, no matter how much they may conflict with anyone's definition of common sense.

Just how far the mining law of the United States departs from a sane man's definition of common sense is evidenced by the constant efforts during the past few years of such organizations as the A. I. M. & M. E. and M. & M. S. of A. to obtain a revision of the law. Those who have been classified by Mr. Parsons as geologists, mining geologists, and court geologists have been among the leaders in this movement because they realize better than any amateur can the difficulties encountered in the administration of the existing law. But so long as the law exists it must be enforced and probably 'court geologists' will continue to be called upon to assist the courts in arriving at their decisions. How some of the judges view the law was tersely put by a Federal judge many years ago when he said: "As long as I am called upon to administer this iniquitous law I must find in favor of the plaintiff".

But a judge must do more than decide in accordance with "this iniquitous law", he is also bound to decide in accordance with the evidence, and whenever he departs from this rule and goes outside the evidence for facts, common sense or otherwise, to support his decision, he is quickly over-ruled by a reviewing court. The particular point cited by Mr. Parsons in the decision of Judge Bollinger was gained from the evidence, and not the evidence of a 'practical' man either, but that of a very clever mining geologist. It would be manifestly improper for me at this time to express any opinion as to whether both the law and the evidence tend to support his decision upon that point, and I will therefore refrain from doing so.

Coming now to the question of testimony by 'practical' men, one must first find a definition of the word 'practical' as used by Judge Bollinger and determine whether a 'court geologist' may not also be 'practical'. Evidently Judge Bollinger thought so, for as I remember the trial of the case, there was almost no testimony given

on structural questions (which were the governing points) except by the geologists and mining engineers.

If by 'practical' Mr. Parsons means the honest practical miner, I have no quarrel with him, for the testimony of such a man is entitled to great weight. But in this world of competitive effort the practical miner who used to be frequently employed in mining litigation has been almost entirely eliminated, and the reasons are not far to seek. In the first place, but for exceptional cases, his powers of expression and description are limited and he is unable to tell the Court what he really knows. In the second place, he is usually quite as strongly prejudiced in favor of his employer as the 'expert' witness, and is much less adroit in concealing that prejudice.

In the matter of partisanship on the part of expert witnesses, it may be said that it is partly due to loyalty to the employer and partly to a desire on the part of the witness to see his honest opinions regarding geological structure prevail. In this respect his partisanship is usually no more pronounced than that of the man who argues for his pet theory in any purely scientific discussion. Geology is not an exact science and there is always a chance for honest differences of opinion; and, while some one must be wrong, it is not always possible for a human being, be he judge or geologist, to determine which one.

Because there are usually two defendable sides to every mining case there are comparatively few cases in which an expert witness having accepted a retainer from one side declines to proceed after an investigation of the facts. But to say that there are none is entirely wrong, as every one knows who has had much practice of that kind. It is doubtless true that there is no "record" of such cases, for naturally no one wishes to have them recorded. The employer does not, for he thinks (and rightly too) that his case would be prejudiced in court if it became known that a competent man had refused after investigation to support him. The expert witness does not, because he does not wish to injure a man who has had sufficient confidence in his ability and integrity to engage his services. The suggestion that the Court employ competent men for independent investigation appears to be a good one and is somewhat along the lines of suggestions which I have made before. Sad to relate, however, in the only case where I have heard that this was done the judge is said to have finally decided exactly opposite to the findings of his own independent investigator. But there were other 'experts' for both sides in that case and he was probably too strongly swayed by the side which held views contrary to those of his 'expert'.

I have suggested that all litigation connected with extra-lateral right questions be submitted to tribunals consisting of one mining lawyer, one mining geologist, and one mining engineer; but I do not know that this would be a panacea for all extra-lateral right troubles. The real remedy, so far as the future is concerned, would seem to be the repeal of the "iniquitous law".

San Francisco, June 17. ALBERT BURCH.

The Editor:

Sir—Mr. Burch possibly has misapprehended the point of view and the spirit of the article in question. An "amateur" must necessarily be a participant in a game, whereas the article merely discussed sundry aspects of mining litigation from the standpoint of a casual spectator, only superficially versed in the ways of the courts and the vagaries of 'justice'. In the first paragraph of his letter Mr. Burch infers that I would substitute "common sense" for "law and evidence"; on the contrary, I simply point out that Judge Bollinger has apparently used practical common sense instead of technical theory in interpreting the evidence and in construing the law. However, I feel gratified to have aroused the interest of one whom we all know to be among the foremost and most honorable of the 'professionals'.

San Francisco, June 18. A. B. PARSONS.

Coloring of Glass

The Editor:

Sir—In your issue of June 11 Francis Drake comments on the discovery that white glass under certain conditions will turn purple. If Mr. Drake were to walk down any of the main streets of San Diego, a city blessed with an unusually large proportion of sunny days, he would find that a large number of the electric-light globes have a distinct amethyst tint, and some quite a deep tint. The chemical reactions that bring about this change in white glass are, I believe, no more understood than the reason why high-grade native peroxide of manganese is used in the manufacture of white glass to correct the color that otherwise would be imparted to the glass by the oxides of iron, almost invariably found in some proportion, in the silica used. Inasmuch as ferric salts almost always are of a deeper color than ferrous salts, one would have expected the addition of peroxide of manganese to have exactly the reverse effect to that which it has. The probabilities are, therefore, that the reaction is a physical rather than a chemical one, and that a color is produced by the peroxide that kills the color produced by the iron. Be that as it may, the prolonged action of sunlight brings about chemical change in the manganese salt that causes the amethyst color. This, of course, only clears the matter up to the extent that the amethyst color due to the prolonged action of the sun's rays on white glass is caused by manganese salts, originally introduced to make the glass white.

It is a long time since I had occasion to study glass manufacture, and it is possible that by now some better explanation may be forthcoming.

Victoria, B. C., June 14. F. H. MASON.

THE lead produced in Alaska in 1919, according to the U. S. Geological Survey, is estimated at 687 tons, valued at $72,822, compared with 564 tons, valued at $80,088, in 1918. The output of lead in 1919 was derived from the concentrates of the mines at Juneau.

IN GUADALAJARA

A BUSY CORNER

A CART AND SOME HATS

Scenes in Mexico

IN THE PEON QUARTER of GUANAJUATO

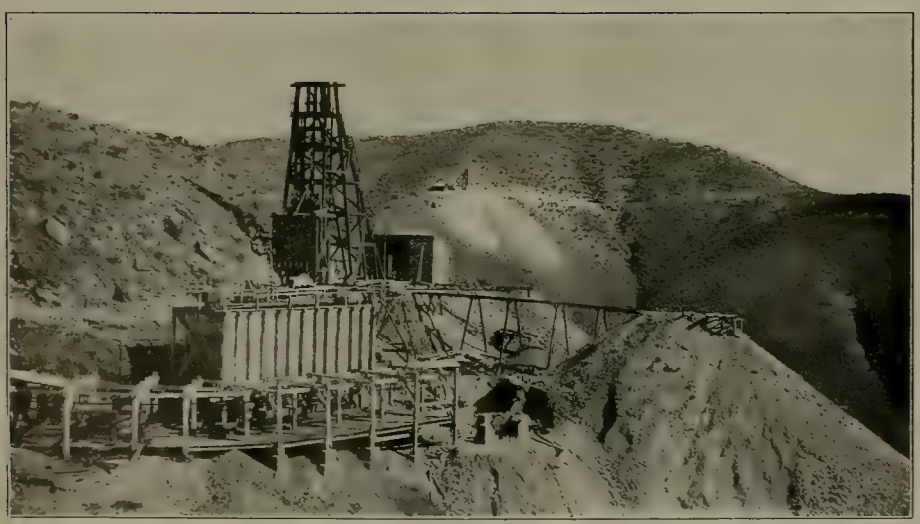
CATHEDRAL AT MOCTEZUMA, IN SONORA

THE CHURCH OF VALENCIANA, AT GUANAJUATO

PORTICO OF THE VALENCIANA CHURCH

THE PALACE OF DON PEDRO, AT PARRAL

ORE-SORTER AT LA LUZ



THE NUEVA LUZ SHAFT AT GUANAJUATO

The Mining Industry of Mexico: A Historical Sketch

Part I

By Robert G. Cleland

The Colonial Period

"When a bonanza has been discovered, the fame of the discovery spreads through the whole kingdom, and the odor of its richness brings crowds from the most remote parts to the newly discovered districts. What was before a waste becomes on a sudden an inhabited neighborhood."—Gamboa, 'Commentaries on the Mining Ordinances of New Spain'.

Introduction. Mexican history is full of striking developments. The most significant of these was the remarkable rapidity with which the Spanish colonists over-ran the vast area known as New Spain and established settlements, and in many places flourishing cities, where only the wilderness or Indian villages had existed before. Behind this dramatic story of exploration, vigorous conquest, and permanent occupation lay many motives. Religious zeal, the haste to forestall any advance of rival nations, an age-long desire for Oriental trade, the eager search for those alluring creations of Spanish imagination—the island of the Amazons, Cibola, Quivira, the mysterious and fabled straits of Anian—these were all factors in the rapid subjugation of Mexico to Spanish rule.

But more far-reaching than any such influences were the discovery of precious metal, especially of silver, and the subsequent development of the mining industry. Indeed, with few exceptions, the history of Spanish advance, after the conquest of Mexico City by Cortez, is simply the story of the opening of fresh mining districts, one after another, and of great rushes to the new finds, which in point of magnitude were not greatly inferior to the Klondike and Goldfield stampedes of our own time. To trace each of these 16th and 17th century rushes (for, as already indicated, the mining rush in Mexico was nearly a century old before the voyage of the 'Mayflower') could require much more space than the limits of this article permit. It is enough to point out that the founding of Zacatecas, Pachuca, San Luis Potosi, Parral, Chihuahua, Nuevo Leon, Monterrey, and a score of other cities of importance in Mexico dates back to the discovery of some rich silver deposit and the establishment of a mining camp, which, almost over-night, grew to be a populous and permanent city. Indeed, from Mexico City to the Rio Grande, outside a few port towns on the Gulf or the Pacific, such as Tampico or Acapulco, one can scarcely find today a Mexican city of any size that was not established as a direct result of a mining boom.

The mines of New Spain not only served as a great stimulant to exploration and settlement; they also constituted the very centre of economic activity throughout the colonies. Aside from the proprietors and laborers who obtained their living directly from the industry, nearly every other business in Mexico, as well as many in Spain itself, depended upon the prosperity of the mines for its existence. The Crown likewise derived the greater part of the revenue received from the colonies either from taxes levied directly upon the product of the mines, or from tariffs upon goods and materials used by the mining communities, or from the royal monopoly of the sale of mining necessaries, such as gunpowder and quicksilver. The merchants were also dependent upon the mining centres for markets; and agriculture, especially in the interior, was carried on almost wholly as an adjunct to the industry. The hordes of laborers and animals employed at every large mine had to be supplied with food; and, in furnishing the corn, beans, *pulque*, and meat, as well as the horses, mules, and hides necessary for the business, Mexican agriculture found its chief incentive.

Social distinction also came from the mining business, especially as the King created a number of noble families from among the wealthier proprietors. The mines of Real del Monte made a poor store-keeper, Pedro Terreros, one of the richest men of his generation, and finally made him Count of Regla. The fortunes derived from the bonanzas of Guanajuato made famous José de Sardañeta, Francisco Mathias, who was created Marquis of San Clemente, and Antonio Obregon, the Count of Valenciana, whose fortune was not far from a hundred million dollars. The Bustamentes were ennobled, thanks to the wealth of Batopilas; and the Fagoagas came into prominence through the Pavillon bonanza at Sombrerete.

The church also derived great revenue from the mines. Sometimes this came from special levies, such as the one that was used to build the magnificent cathedral at Chihuahua; but more commonly it took the form of donations or bequests from generous individuals. Pedro Terreros, already spoken of, not only sent an expedition of sixty monks to the Apache Indians at his own expense, but gave $20,000 monthly for two years and a half to the church of the College of San Fernando, and some $70,000 for other religious purposes. The Bordas, Joseph and Francisco, having made an unbelievably large fortune after various ups and downs, donated more than a million dollars to build and furnish a church at Tasco, where one of their mines was situated.

Mining Law. Mining played a significant part in every branch of colonial life, and contributed largely to

the royal treasury; it was, therefore, an object of great solicitude on the part of the Spanish Crown. An elaborate and in many respects admirable mining code governed the conduct of the industry and regulated its affairs to the most minute detail. This code, which in fact furnishes the basis of Mexican mining law today, consisted, in colonial times, of five parts, as follows:

1. The mining ordinances in effect in Spain prior to 1584;
2. The so-called Code of Philip II, promulgated in the colonies in 1584;
3. Royal decrees, of various dates, generally dealing with specific and sometimes purely local matters;
4. Regulation of individual colonies or provinces; and
5. The systematized and scholarly body of laws issued by Charles III in 1783 and known as the New Code.

Under the code of 1584, and in all laws thereafter, deposits of gold or silver, whether located on public or private ground, were declared the property of the Crown and thrown open to public denouncement. Anyone accordingly could prospect on public or private land "without any hindrance or interruption from the owners, or from any other person whomsoever", subject only to the obligation of paying for such damage as his prospecting or 'trial-pits' might cause. The process of denouncement was hedged about with certain technicalities, which need not detain us here; but it is interesting to note that, under colonial law, a concession to the claim was not issued until the denouncer had sunk a shaft three *estados*, or approximately 20 ft. in depth. If this were not done within three months, the concession was forfeited, and the claim was again thrown open to denouncement. An official inspection had to be made when the shaft was finished; and at the conclusion of this (in all probability a mere formality), the inspector stood at the mouth of the shaft and called three times for prior claimants to appear and prove their right to the property. If none came, the proceedings were closed by throwing a handful of grass or a few stones into the open pit.

The dimensions of the colonial *pertenencia*, or unit of mining concessions, varied under the different codes. The older laws made it rectangular in shape and of uniform size, covering a surface area of 50 by 100 *varas*.[1] Later, although the size of the ordinary claim remained the same, a discoverer's pertenencia was created, 60 by 120 varas in size. Under the law of Philip II, these last dimensions were given to the ordinary claim and the dimensions of the discoverer's pertenencia were increased to 80 by 160 varas. In all colonial laws, the pertenencia was considered indivisible; and, as its planes ran vertically, the boundaries of a claim were definitely fixed both above and below ground, in marked contrast to the uncertainty of boundary limits in the United States.

The law also contained specific regulations to prevent the careless or reckless working of mines, and sought especially to minimize damage from flood or caving, by detailed provisions for timbering, supporting pillars, and unwatering. It is scarcely to be inferred, however, that these elaborate precautions were always zealously or intelligently enforced by the officials charged with the inspection of the mines.

Another interesting feature of colonial law, which has been abandoned and re-adopted with modifications more than once in later Mexican history, was the requirement that all claims should be worked or else become forfeited to the Crown. The Code of Philip II provided that four men, at least, must be kept employed on each pertenencia, and that failure to keep such persons at work for a period of four successive months destroyed all rights of ownership and again threw the property open to denouncement. Only war, pestilence, or famine, occurring within 20 leagues of the mine, could be offered as an excuse for failure to meet this requirement.

In all these laws, the purpose of the Spanish sovereign was to develop the mineral resources of Mexico through individual initiative and at the same time to protect the ore deposits from reckless or careless exploitation. Besides allowing the widest freedom for denouncement, various other privileges were held out to stimulate the industry. Proprietors were granted the use of forests and water to carry on their operations, and were permitted to expropriate either public or private land for mine plants or reduction works. In many other respects, too, the industry was placed on a more favored basis than were other colonial enterprises, but the lot of the Mexican mine-owner was not always a happy one, even with the royal favor behind him. Aside from the natural difficulties incident to his business, there were other obstacles of an equally formidable nature. One of these was the heavy burden imposed by taxes and other government exactions.

Royal Taxes and Monopolies. "Quickesilver is here very deere, for here is almost none to be had for any money to worke in the gold mynes; for without Quickesilver wee cannot refine out gold. And no man upon paine of death may bring any from Spaine hither; but all must come for the King's account; and so the King doeth sell it here; there is exceeding great gaine therein. And thus I rest: From Mexico, the 30 of May 1590".—Bartholomew Cano.

The Spanish government, as already indicated, sought in many ways to encourage the mining industry, an interest that arose primarily from a desire to increase the royal revenue by stimulating the output of precious metals and the sale of mining supplies. Taxes, both direct and indirect, were many and burdensome; and, too frequently, in its desperate need for funds, the Crown imposed such heavy levies that the mines fell into decay and the exports of silver greatly decreased.

The most important of the direct taxes was the royal fifth, or *quinto*, a 20% royalty levied upon gross output. The fifth was afterward reduced to a tenth; but in addition there were assay fees and coinage dues, which brought the total in direct taxes to something over 16% of the gross production. Under the law, gold and silver bullion could not be used in trade until coined at the

[1] A vara is 33 inches. Under modern Mexican law, a pertenencia is 100 metres square, equivalent to a hectare, or 2.47 acres.

mint in Mexico City, but this regulation was impossible of enforcement, and in the northern districts, especially, unstamped silver *(plata pasta)* was the chief medium of exchange. The practice, however, was carried on at a serious loss to the miners, because goods given in exchange for bullion commanded double price, and a marc of silver, worth eight dollars at the mine, brought only four dollars and a half in Chihuahua or Sonora.

Indirect taxes, in the form of import duties and the royal monopoly on gunpowder and quicksilver, were a more serious handicap than the direct levies. At the close of the 18th century, Mexico required fully 1,300,000 lb. of gunpowder annually to keep her mines in operation. The manufacture of this was under royal control, but many illicit factories existed and much powder was also smuggled in through Vera Cruz, so that the royal monopoly was far from complete. The price ranged from six to eight reales per pound, and even the lower figure represented a profit of 200%.

The royal monopoly on quicksilver was far more successful than that on gunpowder, and furnished one of the most troublesome questions in the history of colonial mining. Quicksilver was an absolute essential in the business, and its scarcity or abundance, its cheapness or dearness, largely determined the yearly output of the mines. In the conduct of the monopoly, accordingly, the king was frequently "between the devil and the deep sea". If he fixed the price of quicksilver so as to assure a large profit, he reduced the production of silver, and cut off the royal revenue in one direction while seeking to increase it in another. As the quicksilver mines of Spain (Almaden) looked to the colonies for a market, such pressure was brought to bear upon the king that the mining of quicksilver in Mexico was forbidden.[2] However, while most of the quicksilver came from Spain or from Germany by way of Spain, Mexico also drew upon the mines of Peru, and to some extent derived her supply from China and the Philippine islands, by means of the Manila galleon. The price of the metal varied from time to time, depending upon the will of the individual sovereign. In 1590 it was fixed at 187 pesos per quintal, or 1.87 pesos per pound. By 1750 the price had been reduced to 82 pesos per quintal; in 1767 to 62

MEXICO

Lack of Capital. Another serious difficulty that retarded colonial mining was a lack of the capital necessary to finance the industry in a manner at all commensurate with its needs and opportunities. The joint-stock company, which played such a vital part in England's commercial and industrial expansion during the latter 16th, 17th, and 18th centuries was not known in Mexico. Partnerships were common enough, it is true, and the form of lease known as the *avio* to some degree met the needs of co-operation. Under Charles III also, a mining bank, supported by a percentage of the coinage dues, was established to finance mining ventures; but although this

[2]Occasionally this decree was relaxed, but generally speaking, the prohibition stood.

proved beneficial for a number of years it came to an end with the outbreak of the French wars in Europe, when its funds were sequestrated by the Spanish government and became lost forever to the mining business.

The commonest method of obtaining operating capital in colonial days was a sort of tripartite affair, in which mine-proprietor, ore buyer or *rescatador,* and wealthy merchant took part. The *rescatador,* securing an advance of funds from the merchant, supplied the miner with capital by buying the ore at the mine. He then reduced the ore and sold the silver to the merchant, in whose debt he stood, for a sum much below the market price. Under such an arrangement, operating mines could obtain funds to meet current needs, but the rates of interest were oppressive, and the supply of capital was too limited for large-scale operations.

Of course, where a mine was in bonanza the question of capital took care of itself. But the proprietor, when such good fortune was his, made little provision for the lean years of development necessary when the bonanza ended, or to meet unexpected disaster from flood or fire. Instead of the proceeds of the mine going back into the industry, they went too largely to gratify the lavish tastes of the proprietors or to build and adorn cathedrals, or for other unproductive purposes. As early as 1582, Henry Hawks, an English merchant who spent five years in Mexico, thus described the ostentatious life of those whom the mines were making rich:

"The pompe and liberalitie of the owners of the mines is marvellous to beholde; the apparell of both of them and of their wives is more to be compared to the apparell of noble persons than otherwise. If their wives go out of their houses, as unto the church, or any other place, they go out with great majesty, and with as many men and maids as though she were the wife of some noble man. I will assure you I have seen a miners wife goe to the church with an hundred men, and twenty gentlewomen and maids. . . They are princes in keeping of their houses, and bountifull in all maner of things."

Similarly, about the middle of the 18th century, Don Francisco Gamboa, greatest of all authorities on colonial mining, found that the miner's chief enemy was the miner himself, because, commonly speaking, he was "prodigal, unlimited in his indulgence in expense, luxuries, and vices"—all of which seriously hurt the industry by depriving it of the capital it so greatly needed.

Colonial Labor. Other difficulties, such as lack of fuel, primitive transport facilities, banditry, and danger from Indian attacks, all retarded the industry. But probably the most serious problem of the proprietor was the labor question. The lack of machinery in Mexico made necessary the use of the other forms of power—man or mule. The difficulty of securing labor in early colonial times was partly overcome by the adoption of a form of slavery known as the *mita* system, by which the inhabitants of native villages could be transported forcibly to the mining districts and the Indians compelled to work the mines. Negroes and condemned captives were also used freely; but even under such conditions there was continual complaint of a shortage of labor. Conditions in the earlier years, from the laborer's standpoint, were terrible beyond description. Abuse, privation, accident, and disease carried off thousands of the poor wretches, whom the Spanish conquerors forced into an occupation that bore the reputation of being "attended with every pain which hell itself could inflict"; and, according to some authorities, with inflicting some forms of punishment of which hell itself had never heard.

The following quotation from a Spanish writer, while perhaps somewhat of an exaggeration, gives at least a vivid picture of these conditions:

"The Indians came from seventy leagues and upwards bringing provisions and whatever was needful. And when they had arrived, the Spanish mine-masters would detain them for several days to do some specific work. The provisions they had brought for themselves were soon exhausted; and then the poor wretches had to starve, for no one would give them food, and they had no money to buy it. The result was that some died on their way to the mines; some at the mines; some on their way back; some just after they reached home.

"The number of deaths was so great that the corpses bred pestilence, and for half a league around a certain mine and on the greater part of the road to it, one could scarcely make a step except upon dead bodies or the bones of men; and the birds of prey, coming to feed upon these corpses, darkened the sun."

But gradually the *mita* system died out, and slave labor, except here and there, gave place to a semi-free, semi-peonage system, under which negroes, Indians, and *mestizos* furnished the great bulk of the labor-supply and passed the occupation down from father to son. Conditions, however, were still far from satisfactory. There were plenty of laws, it is true, to protect the laborer from unnecessary danger (for instance, there was an ordinance of Charles III, requiring the installation of proper steps and ladders, and the keeping of these in sound repair), but the enforcement of such laws was seldom taken seriously, unless the safety of the mine itself was involved; and even then, inspectors were not always either conscientious or competent, so that disaster and accidents were of appalling frequency, even at the close of the colonial era.

The labor itself, even barring accident, was still oppressive and ruinous to health. The *tenateros,* or packers, who carried ore and water in rawhide bags suspended on their backs by straps across the forehead, according to Humboldt, "remained continuously loaded with a weight of from 225 to 250 pounds, and constantly exposed to a very high temperature, ascending eight or ten times successively, without intermission, stairs of 1800 steps". Severe as this labor might be, however, it was not so unhealthful as that of the *barenadores,* or powder-men, whose span of life seldom exdeeded 35 years if they continued their occupation beyond a certain period.

Above-ground, conditions were equally conducive to disease. The dust and glare of the patios brought blindness to many of the women and children who broke up the ore for amalgamation. And a large part of those engaged in carrying on the actual process of amalgamation spent their lives "in walking barefooted over heaps of brayed metal, moistened and mixed with muriate of soda, sulphate of iron, and oxide of mercury". Humboldt records that persons so engaged seemed to enjoy perfect health, but one may well question the accuracy

of his statement. In smelting operations, at any rate, the testimony lies all the other way. Here the laborer was compelled to breathe the poisonous fume and vapor that arose for nearly an hour after water had been poured on the hot slag. The men drank unlimited quantities of water, became bloated, suffered acutely from fluxes and stomach cramps, and lost the use of hands and feet.

In the matter of wages, however, the mine employee fared better than any other laborer in Mexico. At the close of the colonial period, he received from five dollars to five dollars and a half, per week of six days, whereas ordinary labor on the haciendas was paid about a dollar and a half. These high wages, however, were somewhat offset by the common practice of paying in goods instead of money. Prices were exorbitant, and not infrequently the laborer was compelled to accept articles for which he had no use. So serious had become the abuses under this system that the Code of Charles III (1783) made the practice illegal, and forbade the payment of wages in "merchandise, effects, fruits, or provisions". The same ordinance required the proprietor to pay his men each week in ore, coin, or bullion and imposed a severe fine if any reduction were made in the rate of wages "established by long usage and adopted in all the mining districts". Accounts were kept by the *rayador,* or paymaster, who was required to see that each man had a sort of tally-sheet upon which the amount of his wages was indicated by circles, lines, and half-lines, to represent the dollar and its various fractions.

Of the actual number of persons employed in the industry during colonial days, there is no accurate record.[3] Humboldt's record of thirty thousand underground laborers, and five or six thousand engaged in various capacities above ground, appears to me to be below the mark. But no other figures can be offered as a substitute.

In many respects, the miner of colonial days was much the same as his descendant of today. From most of the literature of the time, he appears to have been a superstitious, thieving, gambling, licentious, drunken, careless, improvident, and lazy rascal, with a few remarkable and counter-balancing virtues. He would sometimes buy rich cloth or fine cambric to gratify his love of display, only to use the holiday material next day for wadding or as a pad to protect his hands. Saints' days and church festivals were continually calling him off to celebrate. Whenever possible, he got riotiously drunk, especially as the ore-buyers to whom he sold his share of the mine's product *(pepena),* and whatever he had been able to steal during the week, often paid him in liquids instead of coin. The *vingarrote* and *chingirito,* which formed the chief medium of exchange in these transactions, had a kick that the consumer of the strongest of modern jackass brandy might well admire, and led to frequent violence and bloodshed, and an endless amount of lost time.

MEXICAN MINERS AT WORK

Even more annoying, from the operator's standpoint, was the ingrained habit of theft among the employees. This trait, which the mine superintendent in Mexico has always to deal with, has its roots in a long forgotten past.

[3]At Guanajuato, 5000 men were employed above and below ground; while the single mine of Valenciana carried 3100 laborers on its payroll in 1803.

Two hundred years ago, the miners were searched as they left the mines, even as they are to this day in many parts of Mexico, and rather a disgusting process it must have been, from contemporary accounts of the proceedings. The best characterization I have yet seen of the Mexican miner in this respect was given by Gamboa in 1761. In speaking of the mine laborers, he wrote:

"They steal the iron picks and crows; they steal the candles; they steal the ore, by means of very subtle and dexterous contrivances and stratagems; they steal the silver from the smelting works and from the vats and washing places in the amalgamation works, with no less dexterity, under the very eyes of the overseers. Upon one occasion, in the mining district of El Monte, the amalgamator being present, and the workmen shut in, several ingots of silver disappeared from the room, and on the circumstances being investigated, it was found that they had fastened a string to the ingots, which being carried out by the gutter through the force of water, the party posted outside for the purpose was enabled to drag away the silver. They steal clothes and money from each other, and if they continue to elude the searcher at the mouth of the mine, they will afterwards boast in his presence of the thefts they have committed. They steal the rich ore by throwing it among the rubbish. In a word they conjugate the verb 'rapar' in all its moods."

Evidently Gamboa, who was a man of practical experience in the business of which he wrote, spoke from a full heart. He naively added, after this description, that,

"Miners of discreet and Christian spirit generally proclaim a pardon for all thefts every Lent"—because, as they knew there was no chance of recovering the stolen ore, the pardon cost them nothing, and if "every transgression were visited with severe chastisement, the mines would soon be abandoned by the workmen."

METHODS. As already mentioned, Mexican miners made but scant use of machinery. Ore was generally carried in rawhide sacks on the backs of the *tenateros,* three of whom, it was estimated, were commonly required, in large mines, for each powder-man employed. These packers ascended from the lowest levels of the mine by crude steps cut in the rocky wall, or more commonly by means of chicken ladders or poles, notched deep enough to allow a precarious hold for their bare feet. When water became a serious problem, as it did in most mines, an adit *(socabon)* was driven into the hillside to drain the workings. Some of these showed great engineering skill. At Tasco, where silver was first discovered, there was said to be one over a third of a mile long, in which a man might ride a considerable distance on horseback. In the mines of Rayas, at Guanajuato, there was one of similar dimensions; the great adit that unwatered the famous Viscaiña lode, was 7 ft. wide by 8½ ft. high and over a mile long. It required more than 12 years for its construction.

Where an adit was not feasible, the mines were unwatered by *tenateros* with their rawhide bags, or by the crude horse-whims, known as *malacates.* These were also used to bring ore to the surface, and served both purposes reasonably well where conditions were favorable. In most instances, however, they were both inadequate and costly. The rawhide bags, constantly rubbing against the rough walls of the shaft, wore out rapidly; and as they cost from one to two dollars each, the continuous replacement of them constituted a considerable item of expense. One such bag full of water would weigh more than half a ton; consequently, a great number of horses or mules were required to operate the whims in every large mine. The Ramon pit on the Viscaiña lode, for example, in 1783 employed 28 whims, each of which required 40 horses to keep the lower workings free from water. The cost of the operations exceeded $10,000 per week.

The use of so many whims made it necessary, of course, to sink very much larger shafts than would otherwise have been required, thus entailing a heavy expense, which could have been avoided by the use of less cumbersome machinery. The *tiro general,* or main shaft, of the Valenciaña was a striking illustration of this point. Octagonal in shape, its walls lined with masonry for a hundred feet from the surface, and with a diameter of 33 ft., this huge shaft represented the acme of Mexican skill. Twelve years were required to sink it to a depth of 600 ft.; the estimated cost of the entire undertaking was more than a million piastres. When completed, it had a depth of 1730 feet.

In some respects, the colonial operations were carried on with remarkable skill. The common miner was an expert judge of ore and had an abnormal faculty for estimating its value. He was also a great prospector, so that few new districts of any magnitude have been opened in Mexico since colonial days. On the whole, however, the industry suffered severely not only from an insufficiency of capital but also from crude and wasteful methods, and from a lack of technical skill. Humboldt, for example, estimated that two-thirds of the powder used in the mines was wasted; Gamboa, a trained engineer himself, spoke of the mine surveyors and chief *alcaldes,* who had oversight of mining operations, as "strangers to the profession and ignorant of its rules". The ordinance of 1783 sought to remedy this lack of technical training by establishing a School of Mines, in which young men might receive a scientific course, to be followed by three years of practical experience before graduation. Unfortunately, the success of this experiment was destroyed by the revolution.

The metallurgical processes were many and various, but in the case of silver only two are worthy of mention. These were smelting and amalgamation. The great wealth of the Mexican mines lay not so much in exceptionally high-grade properties as in the almost unlimited quantity of medium-grade ore produced.[4] The extraction of this was made possible by the famous patio process, discovered in 1555 by Bartholomew Medina, a mining engineer at Pachuca. To this process, by which at least 75% of the colonial output was obtained, Mexico owed her phenomenal mineral development. Its characteristic features are too well known to my readers to require repetition.[5] Certainly, it was the most distinc-

[4]According to Humboldt, the average silver content of Mexican ore was three or four ounces per quintal, or between sixty and eighty ounces per ton. At Guanajuato, where the patio process reached its highest development, ore yielding about three-quarters of an ounce per quintal was profitably treated.

[5]See T. A. Rickard, 'Journeys of Observation', pp. 129-147, for a full description.

tive feature of Mexican mining, not only during colonial days, but during most of the 19th century as well. In the great silver districts, the *haciendas de beneficio*, with their high white walls, built as a protection against robbery and theft, their courtyards covered with *montons* or *tortas* of metal in various stages of amalgamation, the innumerable laborers breaking ore for the *arrastres* or grinding-mills, and the half-naked men and boys, or droves of animals, treading the huge slime-pits, struck a chance visitor as nothing else connected with the industry.

Salt, magistral, lime, and quicksilver constituted the chief essentials in the patio process. The quicksilver has already been spoken of as a royal monopoly. Salt was also an item of very serious expense and could be produced in relatively few places. Between San Luis Potosi and Zacatecas, there was a famous salt lake—the Laguna del Penon Blanco—which dried up during several months of each year, allowing the salt to be scraped from its bed. The salines of Vera Cruz, Tampico, and Colima also furnished the article in an impure form; the product of various salt springs was similarly utilized. The cost of the salt varied largely with the distance required for its transportation, but even in the place of production it was worth half a piastre per bushel.

The copper pyrite used in the preparation of magistral sometimes costs as high as ten dollars per carga. Quicksilver was used in varying quantities, depending upon the amount of silver contained in the mixture. Generally, the proportions adopted were six parts of quicksilver to one of silver. About as much quicksilver was lost in each amalgamation as there was silver recovered, a percentage of waste eight times higher than that incurred in European mines during the same period. The amount of magistral used in the process varied with the character of the ore, but seldom exceeded five times the weight of the mercury.

Ores that could not be treated by the patio method were calcined or smelted, and then refined. In this process, the Mexican used a variety of methods and furnaces. One of the commonest of the primitive smelters was the *horno* or adobe furnace, which differed somewhat in type from place to place. That in common use in the Santa Eulalia district was about 18 in. wide at the top, 16 in. across the bottom, and stood nearly 4 ft. high. The blast was supplied by bellows at the back, which might be worked by hand or mule, depending on the size of the furnace. The furnace just described held a charge of something more than 100 lb. The chief cost of operation in this method lay in the difficulty of securing charcoal, especially where wood was scarce, and the proper fluxes to be used with the ore.

A STREET SCENE IN CHIHUAHUA

For extraction of free gold, the machinery in commonest use was an *arrastre*. This was a crude drag-mill built usually near a stream of water and turning in a rock and clay or log-wall pit, some 12 ft. in diameter and 3 ft. deep. The bottom of this pit was lined with flat stones and wherever cracks occurred, these were filled with clay. The grinding apparatus consisted of two flat-bottomed stones, weighing five or eight hundred pounds each, attached by rawhide or grass ropes to the lower cross-piece of an upright wooden shaft, set in the centre of the floor. Another bar higher up made a sweep-like arrangement, to which horses or mules were hitched. As these were

driven around, the stones were dragged across the floor and the ore, broken to walnut size before being put into the mill, was ground to powder. A small stream of water flowing into the mill kept it filled to a depth of five or eight inches, the pulp being carried off by the overflow. The gold, sinking to the bottom, combined with quicksilver. About half a pound of this was required per ton of ore, and under favorable conditions as much as 50% of the gold was caught.

PRODUCTION. The figures of production during the colonial period, for reasons which cannot be explained here, are much more likely to be legendary than exact. The yield of certain great bonanzas, however, is fairly well authenticated and may prove of interest. The Cañada, one of the famous properties in the Real de Tlapujuhua, yielded close to 2,000,000 oz. of silver annually when in bonanza. La Esperanza, on the Veta Grande of Zacatecas, produced nearly 4,000,000 per annum. The mine of La Purissima yielded a net profit of over $200,000 annually for nearly two decades, and in 1796 produced six times that amount. Another mine in the Catorce district had a yearly output of nearly $2,000,000. The mines of Sombrerete gave a net profit of $4,500,000 in a few months of bonanza. Quebradilla produced more than $200,000 in a single week; the mines of Pachuca, Bolanos, and Batopilas, to mention only a few at random, were all producers of the first rank. But the mines on the Viscaiña lode at Real del Monte, and the great Valenciaña, probably surpassed anything else in Mexico. The Viscaiña was mined from the 16th to the early part of the 17th century. The workings then became flooded and were not re-opened for half a century. About 1740, however, a miner named Bustamente conceived the idea of running an adit to cut the vein at a lower depth. He died before the enterprise could be completed, but his partner, Pedro Terreros, finished the undertaking in 1762. Before 1774, he had made a net profit of over $5,000,000, and was recognized as one of the wealthiest men in the world. Thirty years later, the mine was still producing close to 500,000 oz. per annum. The Valenciaña first came into bonanza in 1768. Within three years, it was producing about $3,000,000 per annum, and for more than a generation continued this phenomenal yield.

The total production of silver in Mexico, from 1690 to 1803, was estimated by Humboldt at slightly over 1.200,000,000 ounces; the gold and silver together, produced and coined during the same period, had a value of about $1.500,000,000. The output of the two metals for the whole of the colonial period (1525-1810) Humboldt fixes at approximately $2,000,000,000. The average annual yield during the reign of Charles III, when the industry was at its height, was close to $22,000,000, or nearly 20,000,000 oz. of silver and some 60,000 oz. of gold. Considering the purchasing power of money in that day, the Spaniards' lack of machinery and technical skill, and the generations of exploitation already accomplished before the dawn of the 19th century, one can readily understand the significance of Humboldt's apt and often quoted phrase—"Mexico, the treasure-chest of the world".

(To be Continued)

ALUMINUM is almost the only metal available for the manfacture of light alloys, according to W. Rosenhain, whose lecture before the Royal Society of Arts appears in a recent issue of the 'Journal' of the Society of Chemical Industry. Of other possible metals, alloys consisting mainly of magnesium are disappointing; beryllium is not yet available. After describing briefly the process for the production of aluminum by electrolysis of pure alumina dissolved in molten cryolite, it was pointed out that there is no satisfactory method for refining aluminum, and that its purity is dependent on that of the materials used in its manufacture—notably the alumina and the carbon electrodes. Consumption of the latter is approximately equal, weight for weight, to the metal produced, and special petroleum coke having a low ash is essential for their manufacture. The necessity for cheapening the cost of aluminum was emphasized. In this connection mention was made of the new nitride process whereby bauxite, carbon, and nitrogen are made to react at a high temperature with formation of aluminum nitride, which on treatment with soda yields sodium aluminate, with ammonia as a valuable by-product. The cost of preparation of pure alumina by this process is said to be very much less than by the present method. In dealing with the properties of aluminum, it was pointed out that its weakness lay in its mechanical properties, and therefore, for structural purposes where strength is required, alloying with other metals is necessary. The alloys of aluminum present the difficulty that, with the exception of zinc, and possibly magnesium, the range of solubility in the solid state for other metals—such as copper, nickel, manganese, iron, and tin—is low, and the addition of comparatively small percentages of these metals leads to the formation of hard compounds as free constituents, causing rapid decrease in ductility.

SOME years ago it was discovered that many of the laterite deposits of India were highly aluminous, and consisted of bauxite, states an Imperial Mineral Resources Bureau bulletin. Systematic field work by the Geological Survey has proved the existence of extensive deposits of bauxite in many parts of India, and chemical investigations have shown that certain of the Indian bauxites compare favorably with some of the best bauxites of commerce. The richest areas yet discovered in India are the Baihir plateau in the Balaghat district, and the vicinity of Katni in the Jubbulpore district, both in the Central Provinces. Bauxite of good quality has also been found on the laterite plateaux in the western parts of Chota Nagpur and in Sarguja, Bihar, and Orissa; in Bhopal and Rewah States, Central India; in the Satara district, Bombay, and in various parts of the Madras Presidency. The deposits to which most attention has been paid up to the present time are those of Balaghat and Jubbulpore.

An Address to Mining Students

On the Occasion of the Commencement of the Colorado School of Mines at Golden on June 10, 1921

By Frederick Laist

It was with a most profound sense of responsibility and many misgivings that I accepted the invitation extended to me to address you on this, the occasion of your Commencement, and if what I am going to say may prove to be of the slightest help to any one of you in shaping your course on the uncertain and oftentimes stormy sea of professional life, I shall feel that my presence here has not been utterly futile.

I have no desire to stand before you in the capacity of adviser, nor do I feel qualified to do so if I so desired. Young men have often come to me asking advice as to some immediate step they contemplated, and even under such comparatively easy circumstances I have found it difficult to say, "You should do this, or so". How infinitely harder, therefore, would it be to advise an assemblage such as you young men with all your diversity of tastes, ambitions, and abilities. Nevertheless those of us who have been through the mill have seen changes and brought away certain impressions and experiences which it may be useful to pass on to you. Outstanding among the changes of recent years is the passing, to a large extent at least, of the individual engineer—the free lance, as it were—and his gradual replacement by, or absorption in, that greater unit known as 'the organization'.

Through my talk today I hope to leave with you a picture of what it means to develop a great mining enterprise nowadays and of the human machine or organization upon which the successful outcome of the project depends. Perhaps this will aid you to make selection of your course with better chance of arriving at your desired goal.

You are at the commencement of your professional career. You have finished a course of study which is admirably adapted to serve as a foundation or groundwork upon which to build. So far you have done well, and I assure you that you will never regret the time you spent at school. Your four years here have placed you in a similar position with respect to your chosen profession as four years at West Point or Annapolis place the man who selects an army or navy career. You are the commissioned officers, as it were, of the great organization upon which humanity depends for its supplies of metals. In other words, you are presumed to have the basic knowledge which will enable you to become good leaders after you have acquired a practical knowledge of men and affairs.

When you were in high-school and were making up your mind as to what kind of career to follow, whether business or professional, and if the latter, what profession, you knew that whatever choice you made would determine the course of your lives for years to come, and so now again you must make a choice between the various branches of your profession, and the choice once again made, you must carry on, or stand to lose what may well be years of effort.

To begin with, the profession of mining, as it is commonly called, may be divided into two main branches: mining and metallurgy. Mining has to do with the mining of ore. Metallurgy has to do with the treatment of ore. Mining and metallurgy go hand in hand and yet they appeal so differently and require so much knowledge of a special character that in most schools the student is permitted to specialize in one or the other during at least a part of his course.

The mining engineer, aided by his knowledge of geology, concerns himself with the finding of ore, and with the mining of it to the best advantage. The metallurgical engineer receives the ore, and with the aid of his knowledge of physics and chemistry, as exemplified in the various ore-treatment processes, separates the valuable metals from the gangue and from each other.

In the early days of mining, only the richest ores were made use of, and only the simplest methods, both of mining and metallurgy, were known and applied. A comparatively modest capital was sufficient to start a mining enterprise. Those days are past, generally speaking, and now enormous capital is needed for the beneficiation of the comparatively low-grade and complex ores from which our present supplies of metals are derived.

We hear much nowadays about the exploitation of the natural resources of the country—of the people being robbed of their birthright, and so on. This agitation is even extended to include water-power sites, as though water, once over the fall, could ever again be of use to the Nation. Modern mining and metallurgy are so largely dependent upon cheap power that agitation of this sort becomes properly of concern to the mining engineer, quite apart from the self-evident fact that the disuse of water-power constitutes a very serious economic waste, and every engineer as a good citizen should set his face against waste of every kind. Every horse-power we allow to run down our streams means hastened depletion of our limited supplies of oil and of coal, not to speak of the waste of human energy indirectly involved.

It goes without saying that the rights of the people—all of us—must be protected, and it is highly important for our representatives to enact legislation designed to prevent waste of our resources and to protect us from extortion and profiteering. At the same time, it is wrong to hedge around the resources of this country with red-tape so as to repel the capital which must be forthcoming before any benefits can accrue.

Very few people realize how relatively valueless is raw material, in the ground, and what an enormous expenditure of money, effort, and time is required to make it useful to mankind. For example, let us review the development of the so-called 'porphyry coppers', whose growth during the past fifteen years has been one of the marvels of modern mining and metallurgy. As is well known, these properties, practically without exception, were known to mining men and geologists for many years but were considered too low-grade and therefore valueless. In other words, they were not 'ore'. Abortive attempts had been made to work a number of them, but in vain. The Utah Copper Co.'s property was offered for sale in the late '90s for $250,000, and was refused.

About 1900 experimental work had demonstrated to the satisfaction of some of the more far-sighted and venturesome mining engineers that these low-grade disseminated ores might be profitably worked, provided that the operation were carried out on a tremendous scale. The flotation process was unknown in those days, except for the old Elmore oil process, which had attracted some attention but was not taken very seriously. The copper-leaching process was also unknown, or at any rate undeveloped. Water-concentration, therefore, was the only process that offered prospects of commercial success and at best it could only be counted on to recover a comparatively low percentage of the copper minerals. This meant a very small yield from an already low-grade ore in the form of concentrate that would suffer further loss in smelting.

Agreement as to the successful outcome of the first porphyry undertakings was by no means general, and I know of a number of able mining and metallurgical engineers who were exceedingly doubtful as to the possibility of building up a successful business on the basis of such low-grade and difficultly treatable ores; and it required a good deal of courage to undertake the investment of the many millions of dollars needed to determine definitely the value of the deposits and bring them to the producing stage. It was possible to go slow up to a certain point, after which it was necessary to take what was little short of a leap in the dark. However, to the everlasting credit of the American engineer and financier, the leap was taken and successfully spanned the gap, with the result that tremendous reserves have been added to our copper resources, and hitherto worthless rock became valuable ore.

Probably many of you remember, not long ago, in what universal disrepute the oxidized silicious ores of copper were held. Even by the engineers who were developing the first porphyry coppers, the cap of oxidized ore, often referred to, rather contemptuously, as "copper-stained rock", was of necessity excluded from the estimates of ore-reserves, as being of no value. In South America enormous masses of this character of ore were known to occur in the Atacama desert of Chile without attracting the favorable attention of mining engineers, although their copper content equaled and even surpassed that of the porphyries that were being worked with such marvelous success in North America. Finally, their development was undertaken, again by American capital and American engineers. After painstaking experimentation, a process of treatment was devised and then again it became necessary to expend untold millions in an unknown country on a new and relatively untried process. Such is the story of Chuquicamata, and the same is true of the great property of the Anaconda company at Potrerillos.

When the engineers of the Anaconda company came to Potrerillos they found nothing but a few shacks, tunnels, and drill-holes in the heart of the Andes mountains at an elevation of 10,000 ft. Sixty miles from the nearest railroad, and that a railroad only by courtesy, as we understand the word in this country. Thirty miles from water. Thousands of miles from a base of supplies.

The first thing that had to be done was to prove the existence of a sufficient mass of ore. Although the ore-body had been roughly outlined, and, reasoning by analogy, the drill-holes and other workings indicated the presence of an enormous amount of ore, the correctness of this reasoning had to be more definitely established and more accurate information had to be obtained as to grade, character, and composition of the ore before going further.

This work took considerably over a year and had to be done under adverse conditions; all supplies had to be brought thousands of miles by water, unloaded at the port by lighters, hauled over a very poor railroad to a station called Pueblo Hundido, 40 miles in the interior, then hauled from there by means of mule-carts a distance of 56 miles over miserable roads, arriving finally at Potrerillos, 10,000 ft. above sea-level. The country being a desert, it was necessary to haul water for every conceivable purpose, and this water was so poor in quality that wherever it had to be used for generation of steam it caused a great deal of trouble in the boilers.

This preliminary work having been completed, operations could be commenced on the development and equipment proper. Remember that there was absolutely nothing to start with. The problem was entirely different from that of establishing a plant or factory in or near one of our cities. The first thing to be done obviously was to construct port works so that unloading of ships would be attended with less loss and could be done more expeditiously. A site called Barquito was selected, and a pier, warehouses, oil-tanks, and a small temporary power-plant were planned and built.

At the same time, work was commenced on a railroad to connect the mine with the existing Chilean railroad. The new railroad was in itself quite an engineering feat, in that it had to ascend from an elevation of about 2000

ft. to an elevation of 10,000 ft. in a distance of about 56 miles, and at the same time it was felt that in order to make it reasonably economical from the operating standpoint, a grade of 3% ought not to be exceeded at any point. It is quite impossible to convey to anyone familiar only with American mountain scenery, any idea of what it means to build such a road in the Chilean Andes, and I will not attempt to do so here. Suffice to say that at one point it was necessary to get from one side to the other of a canyon 2000 ft. deep, with mountain slopes on either side so steep that it was difficult in places to obtain a foothold for the roadbed.

In order to lighten the loads to be hauled to the mine as much as possible, it was decided to generate whatever power was needed, both in preliminary work, and later for operations, at the sea-coast. This necessitated the construction of a power-line almost 100 miles long.

A site for reduction works was selected about six miles from the mine and at an elevation about 1000 ft. lower. In order to tap the orebody and convey the ore to the crushing-plant, a railroad, running chiefly underground, had to be constructed and electrified. The tunnels on this road aggregate approximately three miles in length, and the last tunnel ends under the main orebody at a depth of 1000 ft. beneath the surface.

While all this was going on, surveys were made and plans were perfected for bringing in an adequate supply of water for milling and leaching operations. This water has to be brought from the Ola river, a distance of over 30 miles, over rough desert country, to the brink of the Pasto Cerrado, across which it will have to be brought in a siphon capable of withstanding a pressure of about 900 lb. per square inch, finally ending at the millsite, three or four miles farther on.

All of this work had to be guided and directed from administration offices established at Potrerillos, and in order to accommodate the staff and the workmen it was necessary to build a town. Houses had to be provided for people of the most diverse tastes and ways of living. A commissary had to be established where everything needed, not only to sustain life but to provide the comforts of life, could be purchased. Hospital, medical, and surgical attendance, police protection, amusements, churches, even a cemetery, had to be established. Obviously it was desirable to maintain good relations with the Chilean government and keep on good terms with the various officials, and this, oftentimes, is not as easy as it might seem, owing to differences in customs and ideals.

While all this was going on, a method of mining and a method of ore-treatment had to be decided upon. The two necessarily go hand in hand, and the mining engineer and the metallurgical engineer must each view his own problem to some extent from the standpoint of the other. This is particularly true when the orebody to be treated is a complex one and contains masses of both oxides and sulphides, as well as mixed ores.

Having settled on the system of mining to be used and the plan of treatment, the necessary stripping must be done, underground bins, cross-cuts, and raises must be excavated, and carefully detailed plans of the reduction works must be made.

The planning of a plant of this kind is in itself a matter of many months and must be followed by the erection of thousands of tons of concrete, brick, and steel under anything but favorable circumstances. Plans have to be made with extra care and attention to detail, owing to the great distance from the base of supplies. As at other porphyry mines, the quantity of ore treated daily will be very large. The plant will be, necessarily, a huge affair and will contain many different departments.

Some of the individual operations involved in the treatment of oxidized or mixed ores require such a degree of technical skill that only a few years ago mining men hesitated to apply them even in the mining districts of this country. For example, the manufacturers of sulphuric acid. Other departments are as follows: coarse- and fine-crushing plants, leaching-plant, precipitation-plant, surphur-dioxide plant, concentrator, smelter, together with such auxiliary departments as power-plant, sub-stations, boiler-plants, foundry, machine, carpenter, and blacksmith shops, and even a brickyard, for the haulage of brick to a point so remote as Potrerillos would be very costly.

Now it must be apparent to you from this outline that the man in charge of a modern mining and metallurgical enterprise must have not only a good technical knowledge but must also be a capable administrator and executive, and the men whom he employs on his staff must have the qualities of loyalty and trustworthiness in somewhat more than ordinary measure. It is obvious that the efforts of the individual can accomplish little in an enterprise of this magnitude. Team-work is the only thing that can win, and this implies on the one hand a chief who has the respect and co-operation of his staff, and on the other hand an organization that will not only carry out orders but is alert and interested and is in itself harmonious in so far as relations between its individual members are concerned.

You have doubtless heard the terms 'centralization' and 'decentralization', and know in a general way what they mean. As a matter af fact, in every successful organization the centralization of authority on the one hand and its distribution among subordinates on the other, or decentralization, must be carefully studied and worked out.

At the head of the local organization stands the general manager, who in turn is responsible to the president and vice-president, whose headquarters are usually elsewhere. Under the general manager come such officers as mine superintendent, reduction-works superintendent, mechanical superintendent, railroad superintendent, chief accountant, purchasing agent, legal and medical advisers. Each of these men in turn has a staff, depending in number on the size and complexity of his department. For example, the mine superintendent will probably have several superintendents under him, each in charge of an individual mine or region. The reduction-works superintendent will have in his department

several superintendents, such as concentrator superintendent, leaching-plant superintendent, superintendent of acid-plants, and so on.

This staff is generally built up of technically trained men, that is, men who have had a course such as yours. Under them come foremen, shift-bosses, machine-operators, and others, all without special training. The young engineers generally start in the engineering or laboratory departments under the immediate supervision of the chief draftsman, chief surveyor, or chief chemist. They are generally promoted according to fairly well recognized principles, taking into consideration ability, dependableness, and length of service.

In addition to departments of the kinds just enumerated, which concern themselves wholly with problems directly connected with operation, the larger companies are devoting more and more attention to building up and maintaining research laboratories, which have nothing to do with operation or production, but whose functions are of a more purely scientific nature. The research department attracts to itself engineers of a scientific rather than an administrative turn of mind and offers a career in pure science with unlimited possibilities. The research department of the New Jersey Zinc Co. and of the General Electric Co. each employs more than 200 men. You can see from this what an important factor organized research has become in modern industry. In these departments are to be found men of the highest and most diverse scientific attainments. Here we find mathematicians, physicists, chemists, geologists, and specialists of all kinds.

The rate of progress that can be attained by organized research is surprising when compared with the accomplishments of the individualistic methods of the past. As an example I might cite the development of the electrolytic-zinc process in the research laboratories at Anaconda. The development of this process did not require the discovery of new scientific principles, but rather the combination of old and well-known principles of chemistry and physics with modern engineering. It had been known for many years that a solution of zinc sulphate could be electrolyzed with deposition of zinc at the cathode and formation of sulphuric acid at the anode, but it is a far cry from making a few grammes of electrolytic zinc in the laboratory without regard to cost by skilled chemists and producing regularly millions of pounds of metal under commercial conditions, implying low cost and the use of relatively unskilled workmen. This was the task of the research department, aided, as the work progresses and assumes larger proportions, by the operating staff.

The electrolytic-zinc process was developed in order to permit of mining certain complex ores that occur in considerable quantity in Butte. These ores contain zinc, lead, copper, silver, and gold. The metals are so distributed, however, that a treatment method which ignored any of them could not be profitable. The lead-smelter could not treat them advantageously owing to the fact that the zinc not only was not recovered but was a serious detriment. The copper-smelter made no recovery of either zinc or lead; and the copper, silver, and gold were in themselves not of sufficient value to pay the expenses of mining and smelting. Selective concentration gave indifferent results, because the minerals contained in the ores were not separable by mechanical means. It was evident, therefore, that an entirely new mode of attack would have to be devised if they were to be made useful.

In work of this kind it is always wise to build on the experience of the past in so far as this is possible. A thorough search of patent and technical literature was therefore made before any laboratory work was started. This search revealed many proposals and tentative processes. Some of these could be eliminated as unpracticable or unsuited to local conditions, but some of them seemed worthy of laboratory investigation. Such investigations were made on three processes before definitely deciding on the electrolysis of zinc-sulphate solutions. All of this preliminary work took the time of probably a dozen men two or three months.

We were now ready for the next step, which consisted of operating the process in the laboratory on a small scale under conditions as nearly as possible identical with those that later would be encountered on a large scale. In this work the cells were operated day and night and the solutions were used over and over again exactly as would have to be done in the large plant. The same acid strength and methods of purification were used and the effect of various impurities on the electrolysis were carefully noted. Exact measurements, with calibrated instruments, were made of the amount of current needed to deposit a pound of zinc, of the roasting temperatures that gave the best results, and in short all the data that could possibly be obtained from a small-scale operation were secured.

It is important to note that this work was done with the process operating in a continuous manner and as nearly as possible duplicating large-scale conditions. You often hear it said that such and such a process worked alright in the laboratory but failed on the large scale. This is due generally to laboratory work that has been planned and executed improperly. The tendency of inventors, and, in fact, most people, is to allow the wish to be the father of the thought and to do their laboratory work under conditions that could not possibly be met in practice, salving their consciences meantime with the utterly false notion that on the large scale they can accomplish what they could not do in the laboratory. This is like the prospector who invariably expects to have his vein widen and grow richer with depth, whereas oftentimes a little unbiased reflection would convince him that the reverse was much more likely to be true. Our Western mining districts are strewn with monuments to man's tendency to self-deception.

Having operated our toy plant for several months without serious difficulties, that is, difficulties that could not be overcome, because difficulties continually kept cropping out, we were ready for the next step. This was

to construct and operate a small plant containing single units of machines, as nearly as possible of standard size. The experimental or pilot plant had a capacity of 10 tons of zinc per day. It contained a full-sized roasting-furnace, leaching, settling, and filtering equipment of standard design modified to meet the peculiar conditions of zinc-leaching, full-sized electrolytic cells, and a small reverberatory furnace for melting cathodes. Various kinds of metals were used in the construction of this plant in order to study the effect of the solutions on them under working conditions and thus determine the structural materials for the large plant. This is very important, as many a plant has failed or required costly alterations owing to the selection of faulty structural materials. Many a so-called acid-proof metal or material has proved to be a snare and a delusion.

In this plant the laboratory data as to roasting-temperatures, acid-strengths, current-efficiency, and so on, were verified or modified, and much adidtional information was collected that could not be obtained from a laboratory operation.

The value of an experimental plant as the predecessor of a large operation may be illustrated by an incident that gave us a great deal of concern at the time, and illustrates the necessity for extreme care when engaged in new work. When the test plant was started, only about one-fourth of the cells were in commission and for the first few days everything went smoothly. As more cells were put in service poorer results were obtained, and after a week or ten days when all of the cells were working the results were extremely poor. The current efficiency fell off to 40% and very meagre and ragged deposits of zinc were obtained.

The research staff made every effort to find the seat of the trouble, but it was a month before it was finally traced to the aluminum cathodes, with which the later cells were equipped, and which, instead of being pure aluminum, were found to contain about 3% copper. At that time no one suspected that such a percentage of copper in the aluminum cathodes could possibly affect the zinc deposit, for in the zinc process the function of the aluminum plate is similar to the function of the starting-sheet blank in copper refining. It accumulates a deposit of zinc which is stripped off when sufficiently heavy without itself taking any part in the reaction.

Also, and equally important, this operation enabled a number of men to be trained to serve subsequently as a nucleus in the final commercial plant. These men became the superintendents, foremen, and skilled operators without whom the large plant would have had hard sledding no matter how good the process and how excellent the design.

Only after all these preliminaries could the large plant be undertaken with fair certainty of success. So far the work had been under the supervision of the research engineer, but now it had outgrown the bounds and facilities of the research department. A separate organization was formed to carry out the construction and operation of the large plant, the research engineer acting in the capacity of adviser, and the men who operated the small plant became prominent members of the new organization.

Doubtless it is now apparent to you why I started out by saying that you must make your choice as to what branch you wish to follow soon after leaving school. Given sufficient ability and capacity for hard work, all the paths lead to the top, but, obviously, if you get halfway along one of these paths and decide you want to switch over to another, you will probably have to start at the bottom again.

Most large mining and smelting companies prefer to train their own men for their higher executive positions. They prefer to have men come to them while they are young and only recently out of school. The new employee's work is closely scrutinized, particularly for the first six months or a year, and his immediate superior is supposed to determine within this time whether he will fit into the organization or not. If he seems to have the necessary qualities, he is gradually given more and more responsibility and after awhile is placed in charge of investigations of increasing importance.

Now there is one thing right here that I cannot impress on you too strongly. First: Your future in the organization will depend on how well you accomplish each and every task that may be given you, however insignificant and unimportant it may, at the moment, seem to you. Second: Your advancement will depend on how well you get on with your associates and with men who may be working under you. You must cultivate a spirit of fairness and a willingness to co-operate. You must treat the men who may be working under you with consideration and must recognize their fundamental rights. No matter how brilliant and able you may be, if you are a 'crab' and constantly fighting with your associates or subordinates you will get nowhere. 'Big stick' methods are out of date. At the same time you cannot afford to allow things to be 'put over' on you. Also if, when you reach a minor executive position, you endeavor to build up your own department at the expense of another department, you are not serving the best interests of the work as a whole, and ultimately you will only injure yourself. All managers realize that a certain amount of wholesome rivalry between departments is a fine thing. The rivalry must, however, be fair and must at all times take into consideration the general good.

When you have reached the position of department superintendent, or what corresponds to it, you are the chief in your department in so far as all matters pertaining solely to your department are concerned. In such matters you have as much authority as the manager himself, and if he is wise he will carefully avoid inserting himself in any way, shape, or form between you and your men. On the other hand, authority brings with it responsibility. You must make good. You must, yourself, carry the burdens connected with the operation of your department and must make your own decisions and see that they are properly carried out. The young executive who constantly calls up his superior and asks him what

to do next instead of using his own head, as a rule doesn't last long.

The theory on which large enterprises are conducted assumes the division of the work of supervision into units, each of which is small enough so that the average man with proper training can grasp and oversee it properly and in considerable detail. The units or departments are brought together into groups or divisions and the aggregate of these constitutes the entire enterprise. The manager at the top of the pyramid is dependent for his success and peace of mind upon each and every one of his lieutenants, and the performance by him of his allotted part of the task, and so you will find that the qualities of trustworthiness and reliability are even more valued than cleverness and brilliancy.

And now, just a few more general observations before bringing my remarks to a close. Accuracy is obviously of great importance and should be cultivated to the utmost. I don't mean the kind of accuracy that insists on reporting an analysis to the third decimal place when you know perfectly well that the method you use is only accurate to the first decimal. That sort of accuracy is actually untruthful and misleading. When reporting on any phase of your work, the report should be clear and concise and, as nearly as you can make it, a true picture of what you are reporting on—well balanced and correct in its proportion and perspective.

Be enthusiastic about your work, make it your hobby—I don't mean to the exclusion of everything else. On the contrary, cultivate an interest in wholesome amusements and good-fellowship, but take an active, not merely a passive, interest in your work. Above all, don't be a clock-watcher or attempt to dole out the amount of service you give your employer according to your idea of the value of the salary you happen to be receiving. Rather, go home each day with the comfortable feeling that you have given more than value received.

Don't get the idea that everything that can be done has been accomplished and that no further improvements can be made. Realize the value of past experience, but don't let yourself be bound hand and foot by precedent. Be constantly on the look-out for opportunities to stop waste, to make use of by-products, to develop new resources, to do things better than they were being done before. Realize to start with that you can only make an exceptional success by putting forth exceptional efforts and know that "He profits most who serves best", and then, as Kipling has so wonderfully phrased it:

"If you can keep your head when all about you
  Are losing theirs and blaming it on you;
If you can trust yourself when all men doubt you
  But make allowance for their doubting too:
If you can wait and not be tired by waiting,
  Or being lied about, don't deal in lies,
Or being hated don't give way to hating,
  And yet don't look too good, nor talk too wise;
If you can dream—and not make dreams your master;
  If you can think—and not make thoughts your aim,
If you can meet with Triumph and Disaster
  And treat those two imposters just the same:
If you can bear to hear the truth you've spoken
  Twisted by Knaves to make a trap for fools,
Or watch the things you gave your life to, broken,
  And stop and build 'em up with worn-out tools;
If you can fill the unforgiving minute
  With sixty seconds' worth of distance run,
Yours is the Earth and everything that's in it,
  And—which is more—you'll be a man, my son!"

ALTHOUGH 85% of the world's supply of asbestos is produced in Canada, it all comes from a comparatively small district about three hours journey from Montreal, states the 'Journal' of the Society of Chemical Industry. There are fourteen principal producers, at Coleraine, Black Lake, Thetford, East Broughton, and Danville. The mining and milling of asbestos consists of quarrying proper, and the cobbing or separation of the fibre from the rock. The first operation in opening a quarry is the removal of the surface soil, usually from 5 to 25 ft. deep, for which steam-shovels are employed. The exposed rock is drilled by hand, machine, or electric percussion-drills. This is followed by blasting with dynamite, every pound of which brings down about five tons of rock. Hand-cobbing separates the crude material into three grades: (a) The long asbestos fibres and pieces of rock containing them; (b) the milling material or rock containing the shorter fibres; and (c) barren rock which goes direct to the dump. The material specified in (a) is sent direct to the cobbing-sheds, where the fibres are separated into different grades both by hand and machinery. The rock containing the shorter fibres is crushed, and the asbestos is separated from the waste by exhaust fans. The asbestos is now ready for the market, and is classed into two grades, termed respectively the crude and the fibre. The crude is divided into two grades, No. 1 having fibres over 0.5 in. long, and No. 2 containing fibre under 0.5 in. These grades are used for asbestos cloth, pipe-covering, and other articles of which asbestos is the principal constituent. The material of shorter fibre is used in other manufactures, chiefly as a filler. The production of asbestos has grown from 1400 tons, valued at £30,000, in 1885, to 120,000 tons, valued at £2,250,000, in 1919.

STATISTICS recently issued by the Bureau of Domestic and Foreign Commerce show the increase of the mercantile marine of this country as regards trade with Great Britain. The net tonnage of American ships that entered British ports with cargoes during the first three months of 1913 was 152,653; for the same period of the present year it was 534,004. It is, however, pertinent to note that the net tonnage of American ships that were cleared with cargoes from British ports during the latter period was only 238,166. One-way merchandise movement may indicate national prosperity, but it militates against the economical operation of the vessels.

CHROME-ORE PRODUCTION in South Africa during 1920 was 60,269 tons, valued at £245,378, as compared with 35,282 tons, valued at £142,541 in 1919, states a consular report.

Industrial Morale

By Richard V. Ageton

Morale has been defined as "that mental state which renders a man capable of endurance and of exhibiting courage in the presence of danger". The dictionary further informs us that the word is of French derivation and is particularly applicable to the state of mind of an army. We frequently hear references to our army of industry, or to our industrial armies, and the comparison is a very apt one when one considers the morale of each, the methods used in obtaining and maintaining this morale, and, finally, the ease with which morale can be completely destroyed.

Particular attention has been given to the morale of our armies, for a serious defeat on the field of battle would be a national disaster. It has not been until the past decade that serious attention has been given to our industrial morale; this despite the fact that a more serious disaster threatens the country, should we suffer defeat to our industrial armies.

In our army-training camps, during the late War, every effort was made to foster and support the morale of the individual recruit so that the troops as a whole would have the proper mental attitude toward their work. The medical corps, under the direction of the camp commander, made it their duty to see that the troops were furnished with proper food, sanitary camp-grounds, and orderly barracks. Numerous societies volunteered to equip and maintain suitable places and forms of amusement. Show-houses, club-houses, libraries, and pavilions were built, and many of the foremost actors and musicians of the country donated their services to carry on with the entertainment. The result of these endeavors was made evident to all of us.

In civilian life everthing is different. It is our own morale which we must strive to build up and maintain; consequently, unless we receive assistance from others, we are liable to fall short of our highest attainment.

The safety engineer's work not only includes the actual inspection of working-places, with the view of maintaining safety, but in many of the smaller towns theirs is a tacit leadership in the amusement and recreation enjoyed by the inhabitants. In the larger cities they lead by suggestions that have a tendency toward the development of civic pride.

The old-time mining camp, like Topsy, "just growed". The result was fearful and wonderful to behold. String towns, three, five, and sometimes ten miles long, were built along either side of a dirty and literally stinking little creek. There was absolutely no thought of sanitation. Each individual had to care for his own water-supply, and a systematic garbage-disposal system was unheard of, unless one could call the universal practice of dumping the garbage in the aforementioned creek systematic. Houses were placed side by side, butting into each other in such a manner that privacy was impossible; modern two-story dwellings side by side with two- and three-room shacks, built from the leavings of the mine-timber dumps; no trees or grass plots, except an occasional one around the company's office. The food-supply was in many instances nearly impossible. If more than one company were operating in the town, one had to trade at the store operated by the company for which he was working, or 'get his time'. Such were the conditions to be endured by the married miner; for the

AN OLD-TIME MINING CAMP

single man, there was the choice of living with one of these families, or in the company's boarding-house. Many of the children, owing to their environment, were unclean and sickly. The public schools, when they had such institutions, were held in buildings that no longer would serve for any other purpose.

The disorderliness of the town was reflected in the mines. Costly and intricate pieces of machinery were housed in ramshackle buildings, little care or attention being given to their up-keep until they wore out through misuse, when they were replaced; a costly procedure for the mining company. The dry-house or change-house consisted, in many individual cases, of two or three nails driven up behind the boiler in the vain hope that one's clothes would dry over-night. The tools, such as drilling-machines, saws, axes, shovels, picks, and drill-steel, were more often to be found in the waste-piles than at the working-places; and everywhere one found a tired, disgruntled, and decidedly discouraged bunch of men. They would come to work tired in the morning; would put in most of their time grumbling at the lack of tools, lack of air-pressure, lack of ventilation, or general cussedness of the shift-boss, as the case might be; working along so as barely to exceed the minimum acceptable amount of work necessary to draw a day's pay; and go home no more tired than they came to work in the morning. In the

evening, for rest and relaxation, there were the saloons, gambling-houses, or similar forms of amusement. There was no thought of the morrow, or if at all it was to find forgetfulness of the work and surroundings, if only for a few moments.

This program would be continued day after day, until, if the miner were single, he would leave for some other camp; eventually developing into a 'tramp' miner, or 'ten-day' man. The tramp miner is, in many instances, a good miner and the only thing to be said against him is that he does not stay long enough to become acquainted with the company's methods of operation; consequently it never receives as much value from him in return for the money invested as it would were the company to develop in him a desire to remain in that particular locality.

A MODERN CHANGE-HOUSE

If the miner were a married man with responsibilities that would not allow of his leaving for other camps, he would often develop into a chronic grouch and kicker. Frequently such men were the only ones available for the positions of less responsibility and their disgruntled attitude was reflected by all the men under them with whom they came in contact.

In the army we would say that an outfit in which conditions approximated those just described had a decidedly low morale.

Imagine then the difference in the mental attitude of a miner, both toward his work and his home life, when living in a town such as the one just described and when living in a town where the operating company has taken pains and care to build clean well-appointed houses; where there are wide and well-lighted streets; where the sanitary conditions are good; where the water is clean and purified before it is allowed to enter the mains; where the disposal of garbage is a daily ritual; where the supply of food is the best; and where the best obtainable instruction and care is given to growing children.

He goes to work from a clean home, or an equally clean boarding-house; changes clothes in an airy and well-appointed drying-chamber; and goes underground with the impression that the surface conditions around the mine are clean and orderly, and consequently he will unconsciously try to maintain those same conditions underground. Arriving at his working-place he finds his tools sharpened and the shift-boss has a 'Good morning' for him. Things begin to pick up, even for the tramp miner; he can do more work with less effort, and the funny part of it is he will do more and better work; he has a high morale.

When he goes off-shift he again changes his clothes, hangs up his digging-clothes in the locker or on a chain, sure that they will be dry for the morning.

The care of the injured miner has always received more or less attention. Nowadays the miner in such a mine knows that every precaution has been taken to prevent his being hurt, but, that should an accident happen, every arrangement has been made to take care of him. Perhaps he himself has been instructed in first-aid and mine-rescue work; in any event, some one working near him has, as it is a rule in many larger mines that at least 20% of the men must have had first-aid training. Arriving at the surface he is immediately taken to a dispensary, where his dressings are completed by a nurse, and, in some instances, a physician; and from there he goes to a hospital. In many cases the nurse on duty at the dispensary, called the visiting nurse, looks to the health and welfare of the miner's family, thereby relieving him of worries in that respect.

In the evening, after work, he has at his disposal a club-house, where he will be sure to find some congenial soul ready for a game of pool, or a good talk. If he so desires, he can go to the company's library, where he will find many books dealing with any subject in which he may be interested. In the club-house there is generally a room that is used for motion-pictures, open to the public. Two or three times a week in the summer the town band will give concerts in the park, and in the winter there are dances.

The old adage, that "all work and no play makes Jack a dull boy" is applicable to all lines of industry, but especially to mining, where one spends practically one-third of his time underground. Many of the safety engineers appreciate this fact and act accordingly.

The Chambers of Commerce, in the more progressive mining camps, realizing the call of youth for more and

diversified forms of industry, are inviting the establishment of factories in order that both the younger and older generations may find congenial employment and remain at home.

Of course, neither of the conditions described are to be found in their entirety in any one mining camp. However, in the old days there were more camps to which the former description would apply. Nowadays conditions are rapidly changing, and there are many camps to which the latter description could be applied. A visit to one of these newer camps is indeed a revelation and they must be seen to be fully appreciated.

Industrial morale, then, is obtained and maintained by the proper attention to the miner's work, his living accommodations, and his recreations. Regarding the first, he will generally accept dictation from the company, as he feels that this is the company's right, as they pay him for his work. Any interference with his home life, living conditions, or recreation is a subject rife with trouble. Too often the choice of the occupant for the safety engineer's position has not been a happy one, as he has sometimes left the impression that the company was adopting a patronizing or charitable attitude toward the miner. This was regrettable, for the subject must be approached from the right angle of pride in their work and pride in the town.

Mining in Bolivia

Bolivia is the third largest of the South American republics, states a consular report, having an estimated area of 708,195 square miles; some of the frontiers have not yet been definitely established so that the exact area is not known. It has an estimated population of 2,820,000, or about four persons per square mile, being one of the most sparsely settled of the South American countries. About 80% of the population is said to be native Indian, 10% mixed blood, and 10% white, of Spanish descent. Most of the population is found in the plateau region, which covers an area of about 40,000 square miles and lies at an elevation of 12,000 ft. above sea-level.

La Paz, with a population of 107,000, is the seat of government, is the largest city and most important distributing centre in the country, and has an elevation of 12,000 ft. above sea-level; Oruro, with a population of 31,360, is 12,000 ft. above sea-level, is the centre of the mining district, and ranks second commercially and as a distributing centre; Potosi, with a population of 30,000, lies at an elevation of 13,000 ft., and is immediately surrounded by important and productive mines for which it is the distributing centre; Cochabamba, with a population of 30,800, lies on the eastern slope of the Andes, 8000 ft. above sea-level and, being the terminus of the railway, is, to a certain extent, the distributing centre for eastern Bolivia, though most of the imports for that region are brought in through Brazil and Argentina; Sucre, the nominal capital of Bolivia, has a population of 29,437, lies on the eastern slope of the Andes at an elevation of 8500 ft., and is of little commercial importance; Santa Cruz, with a population of about 30,000, is in the low-lying region of eastern Bolivia at an elevation of 1500 ft., and is in the midst of a region that has a great agricultural future, but at the present time, owing to lack of transportation facilities, is cut off from the rest of the world.

The principal wealth of Bolivia at the present time is its mines of silver, tin, copper, wolfram, antimony, and bismuth. The principal exports are tin, rubber, copper, silver, bismuth, wolfram, antimony, lead, and wool. The principal imports are machinery, foodstuffs, live stock, and textiles. The normal rate of exchange is 2.57 bolivianos to the dollar. Bolivia is not a country that could live on its own resources; therefore, its foreign trade is of vital importance. There is no home market for its mineral production, practically all of which must be exported. Few manufactured articles are made in the country and not enough foodstuffs are produced to supply the home demand, so that for both manufactured articles and foodstuffs it is dependent upon imports. It has no direct outlet to the sea, so that all its foreign trade must go through the four surrounding countries, Peru, Chile, Argentina, and Brazil. A greater part of both the exports and imports passes through Chile, which offers the best transportation facilities, and the shortest and easiest outlet to the sea. Great Britain in 1919 still held first place in Bolivian export trade, taking 31% of the volume and a little over 49% of the value. The principal articles exported to Great Britain were tin and silver. The United States, which in 1913 held sixth place, has held since 1915 second place in the export trade. In 1919 the United States took 45% of the volume and 41% of the value of the entire export trade of Bolivia. The principal articles purchased were tin, valued at $16,186,798, and rubber, valued at $2,660,110. Tin has always occupied the most important position, representing, in 1913, 72% of the value of all exports and, in 1919, 69% of the value of all exports. Until about 30 years ago silver was the chief article of export; but, since the development of the old silver mines as tin mines, silver is no longer of such importance, though it is still a leading industry of the country. During 1919 tin ores, concentrates, and bars valued at $3,794,363 were purchased by the United States. This item is greatly in excess of any other item of export. Copper ore ranked next in importance, and wolfram held third place. Very little wolfram- or tungsten-bearing ores have been exported during 1920. Silver products held fourth place in point of value.

To provide fuel for the use of the Alaskan Engineering Commission, coal mining was continued in 1919 in the Matanuska field, Alaska, on about the same scale as in previous years. Near this field and also tributary to the Government railroad, is the Willow Creek gold district, where large auriferous lodes are being exploited. These mining developments are described in a pamphlet by Theodore Chapin entitled 'Mining in the Matanuska Coal Fields and the Willow Creek District, Alaska,' issued by the U. S. Geological Survey, Department of the Interior.

Sampling of Bullion

By R. R. Kahan

*The three methods of bullion sampling that are commonly employed are: (1) by means of a dip-sample; (2) by means of clip- or chip-samples; (3) by drilling the bar.

Dip-Samples. If the bullion is melted at the correct temperature and properly stirred, the dip taken should represent the mass of the bullion, provided the bullion is poured immediately after dipping. This is important; there should be no time for further refinement of the bullion by the fluxes, or reduction of oxides by the plumbago crucible. The dip-sample may not represent the mass of the bullion because, compared to the resulting bar of bullion, the dip has a large surface; oxidation has a greater effect on the dip than on the bar during the time that elapses before quenching. Again, if the oxides are dissolved in quenching, the dip is partly refined; if the oxides are not dissolved, the dip is debased. A little slag adhering to the dip will vitiate the assay if not carefully removed from the assay piece.

Clip- or Chip-Samples. These can only be taken from bullion which is homogeneous; if any liquation has taken place they are unreliable. As a preliminary to taking the sample it is advisable to clean the outer surface of the bar with a file or scratch brush; the sample should be taken over a moderate depth and large area.

Drill-Samples. These are similar to clip-samples, but are more difficult to take, particularly when a large number has to be taken. Unless great care is exercised contamination is liable. Drill-samples are suitable in the case in which a bar is suspected of being non-homogeneous, and which it is not convenient to re-melt. A sufficient number of samples can be made to give a fairly accurate result.

No single method of sampling is applicable to all classes of bullion produced. A dip-sample usually gives a slightly high result, and a clip-sample a slightly low result; drill-samples are not used to any extent where large numbers of samples of all classes of bullion are taken. The word 'slightly' has been used because it is only by examining a large number of results that the difference can be noticed. With fine gold it is a different matter, as it makes no difference if a dip-, clip-, or a drill-sample is taken, provided all precautions are observed with each kind of sample.

At the proposed refinery the bar will be melted with suitable fluxes; when at the correct temperature it will be thoroughly mixed with a specially shaped plumbago stirrer, which has the effect of lifting the molten metal from the bottom of the crucible, not simply setting up a circular motion in the molten metal. Dip-samples will then be taken with a dipping-iron so constructed that the samples will be taken simultaneously from different depths of the molten metal. The dips will be quenched in water, and the bullion, after pouring into ingots of 300 to 350 oz., will be quenched in water slightly acidified with sulphuric acid.

The bars, after cleaning, will be sampled in the presence of two persons, by taking clip-samples from different ingots. Half the number of clip-samples and half the number of the dip-samples will be sent to one assayer, and the remainder of the samples will be sent to another assayer. Each assayer will obtain his results by using different furnaces, different apparatus, and even different methods of weighing, and different proof gold for obtaining the surcharge corrections. In fact, the assay reports will be obtained in different assay offices using methods as different as is possible in bullion assaying. Then if, when the reports by each assayer are finally brought together, it is found that the clip-assays agree within limits, and the dip-assays agree within limits, and finally if the mean of the clip-reports and the mean of the dip-reports agree within certain limits, the mean of the clip- and dip-reports is taken as the fineness of the bar. If for any reason the assay report on any sample is suspected of being inaccurate, a repeat assay is made on the same sample; and if the inaccuracy of the original report is confirmed, the new result is substituted before obtaining the final result.

When the various assay reports considered do not agree, the bar is subjected to further treatment, which may consist of re-melting the bars or of subjecting them to a preliminary refining. Generally, when concordant assay results are not obtained, the cause is due to the presence of an excess of base metal, which must be removed; this is done by preliminary refining. It is important to notice that reliance will not be placed entirely on dip-samples. The dip-samples become separated from the bars before final dispatch to the assayers, and there are possibilities of transposition. Clip-samples are always sent in conjunction with dip-samples, so that an error of this nature is easily detected.

I agree with the suggestion that, with the establishment of the Rand refinery, an effort should be made to standardize methods in all assay offices. It may be taken for granted that the refinery staff will at all times be prepared to discuss standard methods. A portion of the equipment of the refinery consists of sets of troy weights and assay weights standardized by the National Physical Laboratory; in due course it should be possible to arrange for the periodical checking of weights. Also the refinery will have a fine-gold trial-plate certified by the Board of Trade, England.

The refinery will use platinum parting trays to part 72 assays at one time. With platinum at £26 per ounce such a tray, without the cups, cost £257; a full set of 72 platinum cups for such a tray costs another £221. A satisfactory arrangement is to have a platinum tray and silica cups. The silica cups cost about 3s. each, against, say, £3 each for platinum cups, and are probably better for working; the gold cornets never adhere to the silica as they sometimes do to the platinum.

*Abstracted from a contribution to the discussion of a paper on the subject, read before the Chemical, Metallurgical & Mining Society of South Africa.

COST OF RE-TREATING CALUMET & HECLA TAILING

According to a recent report the Calumet & Hecla Co. is in position to make 1,500,000 lb. of copper per month at a cost not in excess of 7c. per pound at its 'reclamation' plant. It is in this department that the sand from Torch lake is treated—sand that in the 50 years of mining prior to 1915 was considered waste and was discarded. It averages over 10 lb. of copper per ton, but in the old days when Calumet & Hecla was mining 'rock' that ran 50 to 100 lb. per ton and above, it was not considered worth saving. In 1913 when the company began to prepare for the treatment of this sand, its engineers estimated there was 40,000,000 tons on the lake bottom which would yield at least 500,000,000 lb. of copper; or, based on a treatment of slightly under 4000 tons per day, it would take 30 years to exhaust the deposit.

In 1920 over 1,378,000 tons of this sand was treated, an average of 3775 tons daily, resulting in a production of 14,138,240 lb. of copper, or an average of 10.26 lb. per ton of sand. This metal was recovered at a total cost of but 6.6c. per pound, or 1c. per pound less than in the preceding year. In 1915 when operations were first started, 181,732 tons was treated, producing 1,582,000 lb. of copper at a cost of 4c. per pound. The following table shows the record to date:

	Sand treated, tons	Production, lb.	Production, lb. per ton	Cost
1920	1,378,500	14,138,240	10.26	6.6c.
1919	915,659	9,082,952	9.92	7.6
1918	715,007	9,245,388	12.93	7.2
1917	730,543	9,075,457	12.42	5.9
1916	545,727	5,412,649	9.92	4.5
1915	181,732	1,582,802	8.71	4.0

NEW RAILROAD WILL STIMULATE PROSPECTING IN ONTARIO

That the Ontario government will give substantial aid to the construction of the Northern Light railway is regarded as certain, the only question being whether it will take the form of a subscription to bonds or a straight cash bonus. The matter is under consideration by the Cabinet and a decision is expected in about two weeks. In the meantime 13 miles of the route through the townships of Teck, Lebel, and Ganthier, in the Kirkland Lake district, have been surveyed. The probability of the construction of the road has given a great impetus to prospecting, and many claims near the projected route which would have been of little value without transportation are being staked. A rush of prospectors has set in to Holmes Township, 20 miles west of Kirkland, on the proposed line where a discovery of gold was made last fall.

ARIZONA

Chloride.—The most recent report of S. F. Eaton, superintendent of the Dardanelles mine, says "further work on the new ore-shoot to the extreme north shows a foot-wall streak of quartz averaging $40. One lense toward the hanging wall assays over $300. A raise has been driven 15 ft. on the foot-wall and some lateral work has been done here. We have ore in both these faces. The vein shows a distinct split on the level just beyond this raise and we are now driving north to determine its course. Ore-platforms are practically full and we will soon have to build an addition. We have on hand nearly $2000 worth of shipping ore. Arizona copper-smelters having closed down for the time being it is best to hold this ore. The total cost of freight to and treatment at a Utah smelter would be nearly $30 per ton This decreases our profit on $45 ore from $30 to $15 per ton. For this reason we are accumulating shipping ore at the surface and in the mine, thus building up a tangible liquid asset which can be realized on as soon as the Arizona smelters resume operations.

Jerome.—The passing of its dividend for the second quarter of 1921 by the United Verde Extension company was not necessitated by the condition of its treasury. With about $3,000,000 government bonds and $500,000 cash the financial position of the company is at once apparent. It also has coming due within the next few weeks some $300,000 for copper sold, while other items swell the current assets to above $5,000,000. And by including its copper surplus, running above 20,000,000 lb., the company has another current asset which would increase the total to around $8,000,000. United Verde Extension fared relatively well in May, with sales aggregating 5,000,000 pounds.

Oatman.—Fire swept the town on June 27, leaving only half a dozen buildings standing among the smoldering ruins of the commercial district. The damage will run from $250,000 to $500,000, with practically no insurance. None of the mines or mine buildings was damaged. Important among the business houses burned were: St. Francis hotel, Grimes hotel, Oatman hotel, Kittleson hardware store, Farrow-Stockpool Auto Motor Co., Fisher building, garage, ice-plant, Oatman Theatre, and numerous warehouses. The fire was discovered at 2:15 p.m. in the annex of the St. Francis hotel, and it spread to adjoining buildings, most of which were structures of from one to three stories. As far as is known no lives were lost, but several persons were painfully burned.

Oatman.—Operations are to be resumed by the Nancy Lee Mining Co. The main vein is opened by an adit from which $20 ore was stoped some years ago. A compressor will be installed for the work about to be done.

Pearce.—Floyd Rash and Joe Mathews have opened a large body of high-grade silver-lead ore in the mine owned by George Bignon and Joe Dickstein, which they are working under bond and lease. Two cars of $50 ore have already been saved. The mine is 15 miles from here and adjoins the old Golden Rule property.

Tucson.—T. H. O'Brien, general manager for the Inspiration Consolidated company, expresses the belief that the mines of the company will not be re-opened before the first of next year. He is quoted as saying:

"Our company at Inspiration is at present developing the west orebody known as the Live Oak. We are preparing to sink the Live Oak shaft as well as the Porphyry shaft of the Porphyry Consolidated Copper Co., which we recently acquired and which will connect up with the lower levels of the Live Oak orebody."

CALIFORNIA

Angels Camp.—The Carson Hill Gold Mining Co. has established a new record for ore treated. During the month

of May 15,070 tons of ore was crushed in the 30-stamp mill, making an average stamp-duty of 18.5 tons per stamp. The sinking of the Melones winze below the 3500-ft. level is progressing steadily.

Carrville.—Axel Carlson and Julius Love have taken a contract to drive a 1200-ft. adit and a 400-ft. raise in the Golden Jubilee mine on Coffee creek. The property has recently changed hands and the new owners plan energetic development.

Colfax.—The Rising Sun Consolidated Mines Co. has suspended production and will unwater the mine below the 700-ft. level. Sinking will be resumed in the main shaft.

Placer operations at the Glenn mine, six miles east of Last Chance, are giving good returns. Owners state that 100 carloads of gravel, of an estimated value of $20 per car, have been extracted this season. About 8000 ft. of tunnel and drifts has been driven by the present management.

Grass Valley.—After six years of work, during which $600,000 was spent, the Grass Valley Consolidated Mines Co. has decided to abandon the Allison Ranch mine. The pumps are being withdrawn and the mine will fill with water.

W. S. Tevis, prominent San Francisco capitalist, has acquired a large interest in the Alcalde gold mine, situated about four miles below Grass Valley. Preparations are being made to sink a vertical shaft and for installation of a modern mine-plant.

The Mineworkers' Protective League has offered to accept a reduction of 50c. per day in wages, but refuses to consider the $1 cut made by the operators. Conferences are being held in an endeavor to reach a compromise and prevent a threatened walkout. Many of the leading companies have already cut their forces and are apparently preparing for a total suspension of operations.

Hayden Hill.—H. P. Anderson, owner of the Consolidated mine, situated near the Juniper, where rich ore has recently been found, announces that he will commence development on his property.

Murphys.—E. C. Norris, of Los Angeles, states that he has $400,000 available for the development of the Murphys Flat and Ora Plata mines. It is planned to run a long adit from the San Domingo side of the hill.

Redding.—Rehabilitation of the famous Black Bear mine, near Yreka, has been undertaken by F. A. Gowing of Piedmont and associates. The old tunnels are being cleared and the surface equipment overhauled. The Black Bear was a prominent producer of gold in the pioneer days of Siskiyou county and for several years was one of the leading gold mines of California.

IDAHO

Coeur d'Alene.—Another find that may prove important is reported in the Alhambra mine. The shoot is said to be three feet wide, showing high-grade gray-copper ore, on the hanging-wall side, which is about 20 ft. wide. The east drift on the property is some 4000 ft. long and in that distance three different ore-shoots have been cut. One shoot, 200 ft. long, carrying gray copper, was opened some time ago and another shoot 40 ft. long was exposed recently. The company is overhauling its mill.

Galena ore has been found in the property of the Red Monarch Consolidated Mining Co. adjoining the Callahan in the Beaver district. The body is said to be 22 in. wide. At the point of discovery its width was little greater than that of a knife-blade. The winze followed ore for 15 to 20 ft. Development was started at a point 50 ft. from the main cross-cut. This is at a depth of 1000 ft. and near the 2900-ft. point in the tunnel.

George Austin, manager for the Rainbow Mining & Milling Co., has let a contract for 50 ft. of sinking on a showing of silver-lead-zinc ore at a point in the tunnel 250 ft. from its portal. The company also will raise on copper ore exposed in the last 200 ft. of drifting to a point 1300 ft. from the portal of the tunnel.

The Rex Consolidated Mining Co. is proceeding with the development of its property in the Nine Mile section, according to E. P. Murray, superintendent. A drift on the Okanogan vein has been advanced 60 ft. at the 400-ft. depth.

MICHIGAN

Houghton.—The Quincy is one mine that will be in splendid shape to resume operations when the copper market revives. With the improvements that have been made in the mills and smelters, and underground conditions never better, Quincy will be in a position to effect a considerable saving in cost. Quincy's new furnace, having a capacity of 150,000 lb. of copper daily, will be completely equipped within a month's time. It has been partly in use, but its casting equipment has not been wholly installed. The furnace is of a type similar to those in use at the Michigan and Calumet & Hecla smelters, with certain improvements which contribute to economy of operation. All material to complete the furnace is on the ground, but the work is being proceeded with leisurely, as there is no particular necessity for speed.

In the milling plant all but one of the five units have been equipped with re-grinding machinery, which resulted last year in a 10% saving, increasing the copper yield by that much. The one unit not so equipped has been remodeled, however, and is ready for the installation of regrinding equipment.

Underground, Quincy 'rock' is showing increasing richness with depth. Advantage has been taken of the lull in the copper demand to extend the openings and deepen the shafts, and the mine now perhaps is more extensively opened, so far as new drifts are concerned, than ever before. Last year the tenor of the 'rock' stamped was 7.36% higher than that treated the preceding year.

Progress is being made with the Calumet & Hecla geological survey, although it is yet too early to say whether or not its objective will be reached. A corps of eminent geologists and mineralogists are engaged in this research, which is primarily to discover, if possible, the orign of the Lake Superior copper deposits and the manner in which they were laid down. Many data are being collected, not only in the mines of the Calumet & Hecla, but in other properties of the district. It is possible that before the investigation is completed that old theories will be shattered. It is the hope of Calumet & Hecla to establish certain fundamental facts that will greatly aid in the uncovering of new copper deposits, therby doing away to a large extent with the present hit-or-miss methods of exploration and development which have proved so costly in the past.

No metal to speak of is now moving out of the district. No new orders have been received of late and practically all copper heretofore ordered has been shipped. Calumet & Hecla has one carload of wire bars to go out to a Middle-West concern, consisting of 80,000 lb. This completes all of its metal orders. Twenty-five men were laid off at the Calumet & Hecla smelter this week, but about 200 are still employed. Seven furnaces out of twenty-four are in operation, but it is possible that some of these will be shut-down. The depression in the district caused by the closing of the majority of the mines has given an impetus to farming and many new farms are being started. It is estimated that 500 new farms will have been taken up here this year.

MONTANA

Deer Lodge.—The new ball-mill in the concentrator at the Champion mine of the Butte-Jardine company is grinding 125 tons per day. The plant is equipped with Dorr classifiers, Janney flotation machines, and a Portland filter. The concentrate averages $280 per ton. Ore rich in silver has been entered in the face of the 1700-ft. tunnel.

Jens.—At the Forest Rose mine, owned by the Butte & Western Mining Co., sufficient ore has been developed to warrant the erection of a concentrator. In addition to second-class ore some high-grade is being saved.

Libby.—Oscar Nordquist, superintendent of the Lukens-Hazel mine, has purchased a new pump which will be installed in the shaft at a point about 50 ft. below the main tunnel. Sinking is progressing at the rate of about 2½ ft. per day.

Neihart.—Ore is being shipped from the Hartley mine and from the Ludlum mine, being operated by L. Heitman. Lessees are at work at the Big Seven and Galt properties.

NEVADA

Arrowhead.—Ore 8 ft. wide and estimated to be of mill-grade for this width, with an 8-in. seam of rich material, has been found in a winze at a depth of 380 ft. in the Arrowhead, the greatest depth at which work has been done. The winze is being sunk a short distance west of the shaft.

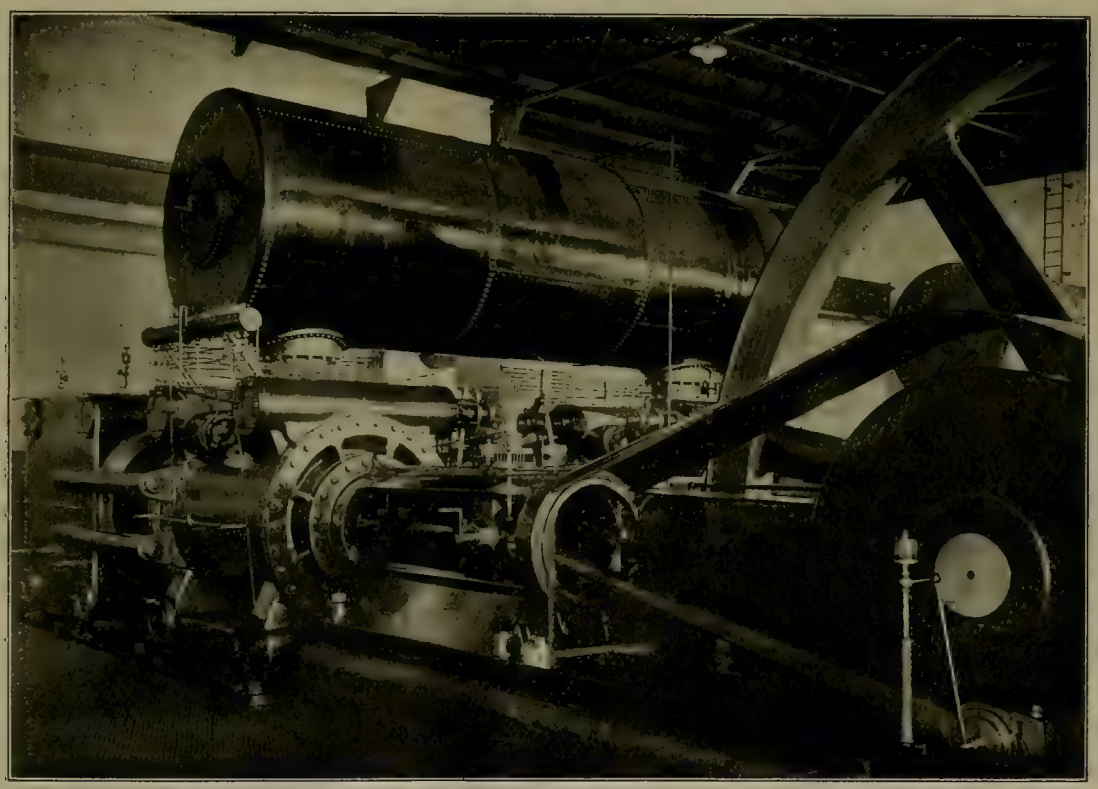
Goldfield.—Donald and Giles, Florence lessees, now have exposed in the hanging wall of the Reilly stope a 12-ft. shoot of ore. This ore is on both walls of a vein about five feet wide, with a 3-ft. width of gangue between. The last samples taken gave: Foot-wall, 10 in., from face of drift, $536. Hanging wall, 16 in., $112; 2 in., $11,000. An assay taken over an area of 5 by 1 ft. in the back of the drift gave $480; 8 by 1 ft., $2744; 12 ft. by 6 in., $142. The $11,000 ore is being sacked for shipment to Selby. The ore is at a depth of 265 ft.——The Silver Pick has opened a promising orebody in the foot-wall of the Red Top vein in ground leased from the Consolidated. About 30 tons of ore estimated to average $50 to $75 per ton has been broken in a 35-ft. drift. The find was made at a depth of 265 feet.

Leadville.—The fourth shipment of concentrate has been made by the Leadville Mines Co., operating in northern Washoe county, 40 miles from Gerlach, on the Western Pacific. The concentrate is sent to the Western Ore Purchasing Co. sampler at Hazen. These shipments average about 225 oz. silver and 50% lead per ton, and the net value of each shipment is $6500 to $7000. The mill-heads assay 20 oz. and, treating 30 tons of ore daily, three tons of concentrate is produced. An electric locomotive is used to haul the ore through a 1700-ft. tunnel to the mill. The ore is a sulphide that is treated by flotation.

Round Mountain.—The second shipment of bullion from the Round Mountain placer mine was sent to Tonopah a few days ago. It had an estimated value of $21,000.

Silverhorn.—A new find of ore that assays $42 per ton across two feet has been found near the south boundary line of the Silver Dale group, about 600 ft. south of the Huson shaft, where the first rich ore was found. Development is now under way to determine if the new find is on the extension of the main vein, or on an entirely different one. Development continues in the north cross-cut on the 50-ft. level of the Huson shaft and in the tunnel below which gives 100 ft. of 'backs' on the vein.——Ore running from $11 to $14 per ton is reported from the Nickel group of the Silver Horn Mining & Development Co., controlled by Robert Mulford, of New York.

Spring Valley.—Rich silver-gold ore has been found in a new district called Millick, in south-eastern White Pine county. The find was made by John D. Tilford on claims in which Richard and Arnold Millick and John Krotzer are interested. There has been a rush into the district and hundreds of claims have been located. The rich ore was found on the surface.



Nordberg Blowing-Engine at the El Paso Smelter

Tonopah.—The 50-ton mill of the Consolidated Spanish Belt has been nearly completed, 45 miles north of here and near Manhattan. Wet concentration and flotation will be the processes used in treating ore containing silver, gold, copper, and lead. The ore, after passing over the concentrators, where tests indicate 60% of the metallic content will be recovered, will be treated by flotation. The crushing equipment consists of ten 1050-lb. stamps. The nearest railroad point is Tonopah and all of the mill machinery was hauled from here. The mine is in condition for a steady production of ore from the workings above the main tunnel, which connects with the 525-ft. San Pedro shaft at 2400 ft. from the portal.

A 3 to 4-ft. width of 125-oz. ore has been opened in the Olsen lease on the Halifax at a point a short distance above the 1000-ft. level. A 1-ft. width assays $750. This is said to be the highest-grade ore ever found in equal quantity in the eastern part of the Tonopah district and if it develops to be more than a pocket it will mean a big jump eastward for the line of the proved ore-zone.

Fifty State policemen, 25 of them in uniform, arrived from Reno on June 27 to assume charge of the strike situation here. The police were sent following complaints by the Tonopah Belmont and Tonopah Extension mining companies that their men have been frequently assaulted and intimidated. They have a total of 350 men working. Governor Boyle notified the mine-owners that the workers are entitled to protection and the State will see that it is given them. Miners and millmen are said by the owners to be arriving in Tonopah to act as strike-breakers. The strike has been on since April 16.

Virginia City.—Guided by R. H. Elliott, Western manager for the Metals Exploration Co., and with Henry Rives, secretary of the Nevada Mine Owners' Association, Roy Hardy and Edward Higgings, of the United Comstock Mines Co., and G. H. Hutton, manager for the Canyon Dredging Co., sixty members of the San Francisco section of the American Instutute of Mining Engineers visited the project of the United Comstock Co. on the American Flat, south of Gold Hill and the gold-dredging operations near Dayton on June 27. A business meeting at Minden and a visit to the North End mines completed the program.

UTAH

Alta.—R. O. Dobbs, manager of the Louise mine, states that high-grade ore has been cut in the connection made between two raises from the Maggie tunnel. The ore, which is galena, lies along the Cardiff overthrust between the Defiance fissure and a minor fault. On June 21, the first train to arrive in camp over the Little Cottonwood Transportation line marked the beginning of the shipping season of 1921.

American Fork Canyon.—John Cleghorn, manager for the Globe Consolidated Mining Co., announces that operations have been resumed. Last season, 550 ft. of development work was done. In the No. 2 fissure, a small quantity of ore was uncovered last year that averaged 99 oz. in silver, $1.80 in gold, and 72% lead.——Excellent progress is being made in driving the Holden tunnel by the American Leasing Co., which is developing the Bellorophon and Live Yankee properties, according to C. B. Ferlin, manager. The company is driving the tunnel to cut the downward extension of a rich shoot opened last year in a raise.

At the Pittsburgh mine, in the main canyon, a force of men is cleaning up the workings, preparatory to resumption of development. W. J. Craig is in charge of the work. This property is at an elevation of 10,200 ft., and there has been snow on the ground until recently.

Eureka.—The directors of the Tintic Standard Mining Co. have declared a dividend of 5c. per share, payable July 9 to stockholders of record July 1. Last quarter the same amount was distributed. This disbursement will bring the grand total of dividends to $1,538,332.——Ore shipments from this district for the week ending June 18 totaled 137 cars, of which the Tintic Standard shipped 49; Chief Consolidated, 39; Dragon, 14; Eagle & Blue Bell, 7; Iron Blossom, 6; Iron King, 6; Colorado, 5; Mammoth, 4; Victoria, 4; Swansea, 4; Eureka Mines, 1; Martha Washington, 1.

A night shift, consisting of 50 men, has been put on at the Blue Bell and Victoria mines, owned by the Bingham Mines Co. This action followed the announcement by the American Smelting & Refining Co. that it would again receive ore from these two mines. Late in March, the mines were informed that only 50 tons of ore per day would be accepted. It is stated that some of the richest silver-lead ore ever opened in the Tintic district is now exposed in the stopes of the two mines, but on account of the low price of lead, this ore has not been marketed.

Mining operations were started in the Swansea Consolidated property by the Tintic Milling Co. on June 19, according to Theodore P. Holt, superintendent for the latter company. For the past two months a force of men has been repairing the shaft down to the 500-ft. level of the Swansea, and an electric hoist and compressor have been installed. The first work will be on the 500-ft. level, where there is said to be a large tonnage of milling-grade ore.

Rapid progress is being made in the sinking of the shaft at the Independence mine, in the eastern part of the district. During the first twenty-one days of June, the shaft was sunk 72 ft., with but one shift employed. The shaft is now at a depth of 400 ft., and will be sunk to the 500-ft. level.

Moab.—W. S. Skelly and associates of Salt Lake City are at Cisco, making preparations to start operations on the placer properties there. Operations will be undertaken on the Butte and Helen claims. The intention is to put in a Walling machine, with a capacity of ten tons per hour. The sand is said to average 90c. in gold and 70c. in platinum.

Ophir.—James Worthing, superintendent of the Ophir Silver mine, reports that the shoot of shipping ore in the second Buckhorn fissure has widened and grown richer. The ore averages now $50 per ton. A new compressor is being installed.——At the Ophir Hill Consolidated property, about 150 men are now employed in the mine and mill. One carload of high-grade ore is being mined per day, while the concentrate from the mill is being stored.

Park City.—Shipments of ore from this district for the week ending June 18 totaled 887 tons, as against 1109 tons for the preceding period. The Judge companies shipped 382 tons; Ontario, 286; and the Silver King Coalition, 269.

Salt Lake City.—Ernest Bamberger, general manager for the Ontario Silver Mining Co., returned on June 20 from Washington, D. C. Mr. Bamberger attended a conference there, at which were present representatives of the lead mining and smelting industries, regarding tariff on lead ores, lead in copper-matte, and other forms. He feels confident that favorable tariff legislation will be passed early in July which will terminate the dumping of foreign metals and other raw materials in this country. Mr. Bamberger stated that during April, 12,000 tons of shrapnel was imported under the guise of type-metal, paying the low duty of 15% ad valorem. This material is not type-metal, but an antimony-lead alloy. This, he believes, in part explains the recent drop in the price of lead.

In spite of the protest of the Utah Chapter of the American Mining Congress and numerous citizens against granting permit to sell 467,100 shares of stock of the Bingham-Galena Mining Co. at a maximum price of 75c. per share, the State Securities Commission granted the permission for such sale. The decision marks the end of one of the most hotly contested cases in the history of the Commission, and the opposition was based solely on the fact that George Graham

Rice and his associates are to have charge of the selling of the stock.

WASHINGTON

Northport.—The Keystone Lead Mining Co. has been organized to develop property consisting of a group of 12 full claims adjoining the Electric Point mine on the east.

Springdale.—Sacked silver ore from the Queen and Seal mine in the Deer Trail district is being stored here pending shipment to the smelter. The ore is high-grade and hand-sorted, and is being delivered by auto-truck at the rate of five tons per day.

WISCONSIN

Benton.—The Nightingale Mining Co. has shut-down its mine on account of the constantly decreasing price for ore.

Unloading-Bridge at the Utah Copper Co.'s Leaching-Plant at Garfield

Latest quotations put 60% zinc concentrate at $20 per ton. The average zinc concentrate for the district is about 30%, and at ruling quotations such ore would bring less than $10 per ton. A discovery of carbonate zinc ore, sphalerite, and lead ore was made recently on the Sally Waters tract. The property is being developed and will be equipped and ready to ship ore when the markets improve. Robert McGuire, of Benton, is in charge.

Day Siding.—The North Unity mine of the Vinegar Hill group is operating steadily. Shipments have been regular until quite recently. The mine is regarded as one of the best zinc producers in the field.

Highland.—Mining properties owned by the New Jersey Zinc Co., have been leased to local operators, who are mining for carbonate-zinc ore. The New Jersey Zinc Co. has practically abandoned most of its mining properties in the Wisconsin zinc-lead district.

Mineral Point.—Operations continue at the works of the Mineral Point Zinc Co., on a restricted schedule. The sulphuric-acid plant is shut-down but two blocks of zinc-oxide furnaces, twelve double compartments to the block, are kept warm. Shipments of the manufactured product are made but in smaller volume than has been customary in other years.

Livingston.—The Yewdall mine, operated by the Vinegar Hill Zinc Co., is producing weekly about 300 tons of 30% zinc concentrate, this ore all going to the National Zinc Ore Separators, at Cuba City. The ore is burned for sulphuric-acid base, and the high-grade blende recovered is being stored, there having been no shipments of 'commercial' zinc ore in two months. At the sulphuric acid plant in Cuba City improvements in methods have raised the grade of the acid, so that shipments are made weekly of three 40-ton tank-cars of 66°B. A shut-down in the plant will be ordered shortly and additional installations will increase the plant capacity 25%. When running full blast, this acid plant will produce 100 tons of acid per 24 hours.

BRITISH COLUMBIA

Barkerville.—Hydraulicking has been started at the Waverly, Lowhee, and First of May properties. John Hopp and associates are working on the Mosquito, and will start hydraulicking shortly.

Nanaimo.—A branch of the Canadian Institute of Mining and Metallurgy has been formed here, and the following officers have been elected: George O'Brien, chairman; F. A. Spruston, vice-chairman; W. H. Moore, secretary-treasurer; John Johns, C. M. Campbell, C. Graham, and J. Strang, council.

Sandon.—The milling capacity of the Silversmith mine at Sandon is being doubled. To this end 35 men are engaged in dismantling the Silversmith mill and enlarging the Ivanhoe mill, acquired by the company recently. Much of the equipment of the Silversmith mill is being used in the reconstruction of the Ivanhoe. The Ivanhoe has a capacity

of 50 tons daily and the Silversmith 150 tons. When alterations have been completed the Ivanhoe will have a capacity of 150 to 300 tons. The Silversmith tramway will be used in transportation between the mine and mill, which are 4100 ft. apart. Ore-pockets are being built at the terminals. Mill construction was started in May of this year and will be completed in the fall, it is believed. The last work done in the mine disclosed ore to a depth of 120 ft. below the tenth level. A carload of ore accumulated in cleaning the old mill was shipped to the Bunker Hill smelter at Kellogg, Idaho.

Slocan.—Clarence Cunningham has been negotiating for property adjoining the Standard mine, and it is supposed that he is the purchaser of the Standard. He has been unusually successful in rehabilitating the mines in this district that were considered to be worked out.——The Great Northern Railway Co. has notified the people of Rossland that it intends to abandon the branch into that town. It has been an expensive line to maintain, and the deficit on the operating expenses for last year amounted to $48,000.

Stewart.—The strike at the Premier mine has been settled, the men having agreed to accept the reduced wage-scale on the understanding that living conditions shall be improved at the camp. As there are some 2000 tons of ore sacked ready for shipment, which the company was unable to transport while the snow lasted, little or no work will be done in the mine for a time, but all energy will be centred on the completion of the mill and aerial tramway. At present about 200 men are employed, but probably this force will be doubled within the next month. Between five and six thousand tons of ore was sent to Tacoma last winter. The company refuses to give any information as to the tenor of this ore. The ore shipped in the winter of 1919-'20 ran 3.175 oz. in gold and 108 oz. in silver per ton, which at the present price of silver would give it a value of about $125 per ton.——It is currently reported that the Guggenheims have bonded the Forty-nine group.——The United States stockholders in the Algunican syndicate, most of the stock of which is held in Belgium, are endeavoring to persuade the Belgian shareholders to continue the work of developing the Spider group, which is believed to be a good property, and one that can soon be brought to a producing basis.

The McAllister mine, at Three Forks, will be re-opened on July 1. At the start work will be confined to development, there being no encouragement for the production of ore at the present time.

MEXICO

Durango.—Ore is being shipped from the old Promontorio mines, situated near Chinacates. These mines are owned by Maximiliano Dam of this city. They are among the oldest producing mines in Mexico. The present shipments are being made to the smelter of the American Smelting & Refining Co. at Chihuahua.——In the Tamazula district, W. C. Taylor is developing a group of gold claims which are yielding good quantities of high-grade ore.——The Santa Cruz Mining Co., an American concern, is shipping silver-lead ore from its mine, situated five days by mule-back from Papasquiaro. S. W. Loving is manager.

El Tigre.—The regular dividend of 5c. per share and an extra dividend of 2c. have been declared by the Lucky Tiger-Combination Gold Mining Co., payable to stockholders of record on June 10. The company owns and operates the El Tigre silver mine.

Guanajuato.—A 500-hp. air-compressor for the Guanajuato Consolidated Mining & Milling Co. has just arrived, together with a number of machine-drills, a drill-sharpener, drill-steel, and other machinery. As soon as this compressor can be installed, the company expects to increase its development work to a great extent. Since the mill was shutdown in February about 750 ft. of development work per month has been done; the results are proving satisfactory, especially in the lower levels. The company hopes to develop sufficient ore of milling grade to justify increasing the capacity of its mill from about 7000 tons per month up to 10,000 tons; by treating a larger tonnage it is expected to reduce the cost per ounce of silver. In addition to the development work in the mine extensive repairs have been made. The tracks, wiring, hoists, etc., have been repaired and put in first-class condition; many of the old timbers in the mines are being renewed.

Torreon.—Two more furnaces at the smelter of the Penoles Mining Co. at Torreon were recently blown-in, making six furnaces that are now in operation. Ore shipments are coming to the smelter slowly and they may not furnish sufficient ore to keep the plant in operation for a long period.

Zacatecas.—The Guarda group of gold-silver mines at La-Noria has been filed upon by Charles E. Snider, who plans to start work. Ore will be shipped to the smelter of the American Smelting & Refining Co. at Aguas Calientes, it is stated. In this district George H. Davis is developing the Purisima mine.——John O. Emerson has made application for title to 94 mining claims in the Miguel del Mesquital district. Included in this list of properties is the old Santa Catarina group which was abondoned several years ago.

ONTARIO

Porcupine.—At the annual meeting of the Dome Mines on June 14, H. P. De Pencier stated that since the issue of the annual report there had been a distinct improvement in the outlook, and production had exceeded his expectations. On the 10th level an ore-shoot 360 ft. in length had been developed and diamond-drilling 300 ft. below the 10th level gave promise of richer ore than had been so far recovered.

The Allied Porcupine, capitalized at $5,000,000, which has acquired properties aggregating 720 acres, including the plant and mill of the Three Nations, having a daily copacity of 40 tons, had made plans for the continuance of lateral work on the 200-ft. level, including extensive cross-cutting to tap outcropping veins, and will also undertake diamond-drilling to test the vein system to a depth of 1000 ft. Cyaniding equipment will be added to the mill.——The E. J. Longyear interests are planning a diamond-drilling campaign on the sand plains lying west of the known gold-bearing area and in the line of the strike of the ore deposits. As the discovery of an extension of the Sudbury nickel deposits, representing many millions of dollars in value, was due to the drilling operations carried on by the Longyear interests, the undertaking excites much interest.

Skead Township.—An important find on the Skead Gold Mines property is reported in a pit sunk 6 ft. A channel-sample across 15 in. of the vein is stated to assay $79 per ton.

Sudbury.—The British America Nickel Corporation has carried through its re-financing scheme and its capital now comprises $600,000 first income bonds, $18,000,000 second income bonds, and $20,000,000 common stock. Edgar N. Rhodes has been appointed president and managing director. A Gronningsater, late chief consulting engineer, has been appointed technical director. The company will resume operations as soon as conditions are favorable.

Toronto.—The annual meeting of the Ontario Mining Association was held at Cobalt from June 16 to 18 with a large attendance. A resolution was adopted strongly urging the construction of the projected Northern Light railway opening up the mining areas east and west of Swastika. Officers were elected as follows: President, R. B. Watson, general manager for the Nipissing Mining Co.; first vice-president, C. V. Corliss; second vice-president, J. P. Watson.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Blamey Stevens is in New York.

Henry M. Payne, of New York, is on his way to Mexico.

Morton Webber is on his way from New York to Mexico.

William R. Wright has left Mexico for Surrey, England.

F. G. Cottrell sailed from New York for Europe on June 11.

Edwin Shapley, recently of Philadelphia, is at Redlands, California.

J. K. MacGowan, vice-president of the Braden Copper Co., is in Europe.

J. W. Hamilton has moved from Eaton, Indiana, to Haileybury, Ontario.

E. H. Nutter, of Minerals Separation, has been in New York recently.

F. W. Denton, of Cambridge, Massachusetts, is at Painesdale, Michigan.

J. Morgan Clements is expected in New York on his return from China.

A. D. M. Rain, of the Braden Copper Co., Chile, was in New York recently.

Frank Scheuber has moved from Melrose, Oregon, to Livingston, Montana.

E. A. H. Tays has moved from Nogales, Arizona, to San Blas, Sinaloa, Mexico.

William L. Boos, of San Francisco, has gone to Cambridge, Massachusetts.

L. H. Goodwin, of New York, is in the Black Hills of South Dakota for two months.

S. T. McElroy has returned to Silverhorn, Washington, from Mt. Montgomery, Nevada.

H. C. Bellinger, vice-president of the Chile Copper Co., left Chuquicamata on June 10 for New York.

O. F. Brinton has been appointed consulting engineer to the Bingham-Galena Mining Co., at Bingham, Utah.

J. E. Bamberger, president of the Ontario Silver Mining Co. at Park City, Utah, is making a tour of Europe.

W. L. Whitehead, after an extensive tour throughout South America, has returned to Cambridge, Massachusetts.

F. G. Janney, general superintendent of mills for the Utah Copper Co., has returned to Garfield, Utah, after a month in the East.

F. G. Cottrell, chairman of the division of chemistry and chemical technology of the National Research Council, is in England.

John L. May, of Salt Lake City, has been appointed assayer in charge of the Salt Lake Assay Office. He took up his duties on July 1.

C. W. Newton, general manager and director of the Callahan Zinc Lead Co., of Wallace, Idaho, has gone to New York to attend the annual meeting.

Ross E. Mills has returned to his home in Salt Lake City, after spending two years in Ecuador as superintendent of a silver mine owned by New York capitalists.

Carl A. Wendell, of New York, has been appointed consulting engineer of the U. S. Bureau of Mines in matter relating to coal washing and coal preparation.

D. D. Moffat has returned to Salt Lake City after a trip to the Ray and Chino properties in Arizona and New Mexico, and to the Shasta zinc property in northern California.

Edwin T. Hodge, professor of ore deposits at the University of Oregon, will spend the early part of the summer in the examination of mining properties in British Columbia.

William Koerner, who has had charge of developing the Flin Flon mine in Manitoba, together with **Richard N. Hunt** and **R. J. Nesbit**, mechanical superintendent at the Mason Valley Mines smelter at Thompson, were at Silverhorn last week.

Robert G. Wilson, chief of the Tax Division of the American Mining Congress, has resigned to form a partnership with **William Huff Wagner**, valuation engineer of the Bureau of Internal Revenue. The firm will be known as Wilson & Wagner, consulting mining engineers, accountants, and specialists in the taxation of the mineral industries, with offices in the Munsey building, Washington, D. C.

Frederick F. Sharpless was recently appointed Secretary of the Institute in succession to Bradley Stoughton, resigned.

Frederick F. Sharpless

Editorial comment, and a brief biography of the new secretary, will be found on page 1 of this issue.

Obituary

James H. Billingsley, president of the Frontier Mining Co., died at his home in Galena, Illinois, on June 16. He was one of the most prominent zinc-mine operators of the lead-zinc district of south-west Wisconsin. He came to Wisconsin in 1905, first developing the Frontier mine at Benton. In succession he developed and operated, with his associates, the Calvert mine, Hird mines No. 1, 2, and 3, the Bull Moose and Middie mines, and others. He was honored several times with election as mayor of the city of Galena, and was a director of the American Zinc Institute. He was well known for his kindly and generous treatment of those in his employ; at one time 700 men were carried on the payrolls of the Frontier Mining Company.

Book Reviews

American English. By Gilbert M. Tucker. Published by Alfred A. Knopf, New York. Price, $5.

A frank discussion of the minor differences between the two great English-speaking nations is always interesting and instructive; the conclusion reached after reading Mr. Tucker's book on American English is that it is strange that so many obvious phases of the subject have escaped attention before. The book is written to disprove the contention of the large number of English writers of note that the pronunciation and spelling of English in America is incorrect and is degenerating. The author quotes from various sources to prove that this is the general impression in England—as it undoubtedly is; but for every Roland, Mr. Tucker produces an Oliver. The result is a collection of interesting extracts and comments.

As regards speech and pronunciation, the author makes an excellent point when he states that if the talk of streetloafers in American cities, and the verbal peculiarities that one may find in the outlying regions of Texas, are to be counted as characteristic of American speech, we must also take just as careful account of the lingo of the slums of London, and Cork, and of the jargon of the less progressive counties in the three kingdoms. To compare the conversation of a London drawing-room with the talk that one might hear in a road-house in Arkansas is manifestly unprofitable; nothing can be learned by such methods. Yet this is precisely what is done by the average Englishman who has never visited America. I remember taking a young friend, who had recently arrived from London, to a New York club for luncheon. After the meal we adjourned to the smoking-room, into which soon strolled a number of members of the club. The conversation of the group first to arrive was distinctly audible to us; one man's voice was above those of the others; my young friend leaned forward and enquired of me, "An Englishman?" I assured him that the gentleman in question had been born in America and had never been out of it. Later on, another group strolled near us, all of them talking the while in a perfectly natural manner. My young friend was now convinced. "Those are Englishmen, anyway", he asserted. "No," I was obliged to reply, "they are all 100% Americans." This explains to some extent the viewpoint taken by many Englishmen.

Another fact that the author emphasizes in his book is that America has no dialects. In England, as the Dean of Ely wrote in the 'Outlook', a west-country peasant cannot understand the artisan of Yorkshire. As proof of this diversity of language in the old country the author quotes the 250 odd glossaries of domestic dialects. A distinguished traveler, once chaplain to Queen Victoria, and one who knew the United States as few Englishmen know it, mentions as "a remarkable fact that the English spoken in America is not only very pure, but also is spoken with equal purity by all classes—spoken in San Francisco just as it is spoken in New York, on the Gulf of Mexico just as on the Great Lakes. There is nothing resembling this in Europe, where every country, as in England, has a different dialect. Often in parts of the country [United States] most remote from each other, in wooden shanties and in the poorest huts, I had this interesting fact of the purity and identity of the language of the Americans forced on my attention, and at such times I thought, not without shame and sorrow, of the wretched vocabulary, consisting of not more than three or four hundred words, and those most ungrammatically used, and always more or less mispronounced, of our peasantry". Who ever heard, asks the author of 'American English', an American gamin call paper 'piper' or lady 'lidy', or rain 'rine'; which reminds me of a story that I heard when I was in Australia: a Sunday-school picnic was being held; a small boy wanted some grapes, but cake came first on the menu. "No", said the teacher, "you eat the 'kike' first; you'll have the 'gripes' afterwards." This is no exaggeration of cockney pronunciation. To be fair, the speech and average pronunciation of the whole of the people of the two countries must be compared; but no cultured Englishman would allow that the dialects of Yorkshire, of Devonshire, and of London are part and parcel of the Briton's pronunciation of English; yet they are, undoubtedly.

There is a paraphrased proverb to the effect that people who live in glass houses should pull down the blinds. The frequent contention of British critics that the language is being mutilated in the United States provokes a rejoinder; the author of this book gives chapter and verse; even the late King Edward's private secretary, (then) Sir Francis Knollys, was guilty of a painful exhibition of bad grammar in a letter written to Professor Rawson, of the Thirteen Club of New York, in 1896. Mr. Tucker criticizes the use of the plural after a negation—a usual British error. Ruskin said: "A daisy is common, and a baby not uncommon; neither are vulgar". The practice is deeply rooted. Even Galsworthy makes one of his heroines say, "Who in our world would marry me if they knew". Phrases like "these sort of people", so common, are also criticized. Anthony Trollope favors another anglicism when he says, "I have done more than slept on it; I have laid awake upon it".

As to variations in spelling on different sides of the Atlantic, the author goes to considerable pains to justify the standard adopted by American dictionaries and American literature. The British practice of writing 'programme' and not 'diagramme', 'honour' and 'honorary', 'armour' and 'armory' results in a jumble of confusion, he says. America has its slang, but so has Britain. The slang of America is usually humorous and incisive; it often gives a remarkable emphasis to what is said or written. British slang is neither humorous nor emphatic. Mr. Tucker quotes from a British novel in which a peer of the realm speaks of doing something "like those millionaires did"; he talks about a "piffling law"; characterizes an approaching wedding as "a beast of a nuisance"; offers to sing "the bally thing"; asks his wife at table, not to pass the jam, but to "shove it along"; tells her to "chuck him another match"; and remarks that something "bucks you up". I should say that the difference between the slangs of Britain and the United States is that here it is the work and thought of authors. I recently came across an acknowledgment by Sir Walter Raleigh, the professor of English literature in Oxford University, who said, in 1918: "For one thing, we on this side now borrow, and borrow very freely, the more picturesque colloquialisms of America. On informal occasions I sometimes brighten my own speech with phrases which I think I owe to one of the best of living American authors, Mr. George Ade, of Chicago, the author of 'Fables in Slang' ". English slang is not copied in America. The proof of the pudding is in the eating; the adoption of slang phrases and words is an evidence that they are part and parcel of our present-day literature. American slang adds to the gaiety of the nations; even Englishmen have an appreciation of its pungency. British slang, on the other hand, is neither witty nor apt.

A large portion of the book is taken up with a critical study of exotic and real Americanisms, with quotations from a number of treatises on the subject. One British critic, after reading in the Albany 'Journal' of a man who came in late one night after an unsuccessful attempt to open the front door with his umbrella, and found himself next morning, "overcoat, hat, jag and all, stretched out in the bathtub", defines 'jag' as "a slang term for an umbrella, possibly from that article being so constantly carried"! A large number of so-called Americanisms are found to be of British origin. 'Guess' was a favorite expression of Chaucer's; the

authors of 'King's English'—a stupid title, by the way—say that "we have it, not from Chaucer, but from the Yankees". Mr. Tucker remarks caustically that were these gentlemen to compile a glossary to Chaucer they would have an entry something like this: "Guess: Americanism for believe, think, fancy". Similarly, if it were a glossary to Shakespeare, there would be an item: "Baggage: Americanism for luggage". The author proves his point that the English language is not deteriorating in America. A large number of Englishmen of high standing have declared that the language spoken in America is, on the whole, purer than the English spoken in England. A critic, like the author of the 'Unspeakable Scot' and the 'Unbounding American', who admits that he has "never been to the United States", but who has the temerity to state that the Americans "having inherited, borrowed, or stolen a beautiful language, willfully and of set purpose degrade, distort, and misspell it" should be put in the class of irresponsible persons whose one object in life seems to be the fomenting of international friction. When the London bus-conductor speaks as do his passengers, then it will be realized why nearly all the people of the United States adopt a uniform language—why such a preponderating proportion use carefully enunciated words.—A. W. A.

Introduction to Qualitative Chemical Analysis. By H. Wilhelm Fresenius. 17th edition by C. Remigius Fresenius. Translated by G. Ainsworth Mitchell. 954 pp., 57 ill. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $8.

The seventeenth German edition of the standard work of Fresenius, which was first planned in 1840, has been remodeled to make it conform to the modern conceptions of chemistry. A chapter dealing with reagents, which appeared in former editions, has been omitted as being no longer necessary; the notes and additions to the systematic course have been tranferred to a separate chapter. The principles of the analytical systems used in the course are made clearer by the addition of tables and general surveys of each stage. The contents of the book are as follows: Part I: General chemical principles and methods of analytical chemistry. Behavior of substances to reagents. Reactions of cations. Reactions of anions. Part II: Systematic course of qualitative chemical analysis. Practical methods of the general course. Practical methods for special cases. Explanatory notes and additions to the practical process. Appendix: Behavior of the most important alkaloids toward reagents, and systematic course for their identification. Remarks on the correct choice of exercises for practice. Tabulation of the results obtained with the substances analyzed for practice. Solubility tables. The translator, who is to be congratulated on having performed a prodigious task, is the editor of 'The Analyst' of London.

Metallography: Part II, The Metals and Common Alloys. By Samuel L. Hoyt. 462 pp., ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $5.

This book is the second volume of a three-book series of which the first volume, on principles, was published last year; the third volume, technical practice, is in preparation. It describes the more important metals and alloys, the description including the constitution and micro-structure, the physical and mechanical properties for different conditions of heat and mechanical treatment, the effects of impurities commonly present, and a brief discussion of the uses. Compositions of particular importance have been treated in detail, and measured values of the important properties have been given. Other features are critical-point diagrams, constitution diagrams, structural diagrams, and photomicrographs.

Recent Publications

Regulation of Explosives in the United States. By Charles E. Munroe. Bull. 198, U. S. Bureau of Mines, 1921. 45 pp.

The Analysis of Sulphur Forms in Coal. By Alfred R. Powell. Technical Paper 254, U. S. Bureau of Mines, 1921. 21 pp.

American Industry in the War. A Report of the War Industries Board. By Bernard M. Baruch, Chairman. 421 pp., index.

Bibliography of Petroleum and Allied Substances in 1918. By E. H. Burroughs. Bull. 189, U. S. Bureau of Mines, 1921. 180 pp.

Ventilation in Metal Mines. A Preliminary Report. By Daniel Harrington. Technical Paper 251, U. S. Bureau of Mines, 1921. 44 pp.

Analyses of Iowa Coals. By George S. Rice, A. C. Fieldner, and F. D. Osgood. Technical Paper 269, U. S. Bureau of Mines, 1921. 28 pp.

Pennsylvania Mining Statutes Annotated. By J. W. Thompson. Bull. 185, Serial 21, U. S. Bureau of Mines, 1920. 1221 pp., index.

Report of Committee on Standardization of Petroleum Specifications. Bull. 5, Petroleum Specifications, U. S. Bureau of Mines, 1921. 71 pp.

Talc and Soapstone in 1919. By J. S. Diller. II:18, U. S. Geological Survey, 1921. 4 pp. From Mineral Resources of the United States, 1919—Part II.

Quicksilver in 1919. By F. L. Ransome. I:10, U. S. Geological Survey, 1921. 32 pp. From Mineral Resources of the United States, 1919—Part I.

The Detection and Estimation of Platinum in Ores. By C. W. Davis. Technical Paper 270. Mineral Technology 31, U. S. Bureau of Mines, 1921. 27 pp.

Underground Conditions in Oil Fields. By A. W. Ambrose. Bull. 195, Petroleum Technology 62, U. S. Bureau of Mines, 1921. 238 pp., index, ill., plates.

Flotation Tests of Idaho Ores. By Clarence A. Wright, James G. Parmelee, and James T. Norton. Bull. 205, U. S. Bureau of Mines, 1921. 70 pp., ill., index.

Water-Gas Apparatus and the Use of Central District Coal as Generator Fuel. By William W. Odell. Technical Paper 246, U. S. Bureau of Mines, 1921. 28 pp., ill.

Accidents at Metallurgical Works in the United States During the Calendar Year 1919. By William Adams. Technical Paper 280, U. S. Bureau of Mines, 1921. 31 pp.

Manganese and Manganiferous Ores in 1919. By H. A. C. Jenison. I:9, U. S. Geological Survey, 1921. 56 pp. From Mineral Resources of the United States, 1919—Part I.

Permeation of Oxygen Breathing Apparatus by Gases and Vapors. By A. C. Fieldner, S. H. Katz, and S. P. Kinney. Technical Paper 272, U. S. Bureau of Mines, 1921. 24 pp., ill.

The Production of Coal and Coke in Canada During the Calendar Year 1919. By John McLeish, B. A. No. 548, Mines Branch, Canada Department of Mines, 1921. 39 pp. Ottawa, Canada.

Permian Salt Deposits of the South-Central United States. By N. H. Darton. Bull. 715-M, U. S. Geological Survey, 1921. 18 pp., map. From Contributions to Economic Geology, 1920—Part I.

The Mineral Industry of the British Empire and Foreign Countries. War Period. Zinc. (1913-1919.) Imperial Mineral Resources Bureau, 1921. 112 pp. For sale by H. M. Stationery Office, Imperial House, Kingsway, London, W.C. 2, England. Price, 3s.6d., net.

THE METAL MARKET

METAL PRICES

San Francisco, June 28

Aluminum-dust, cents per pound	75
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13
Lead, pig, cents per pound	4.65
Platinum, pure, per ounce	$75
Platinum, 10% iridium, per ounce	$105
Quicksilver, per flask of 75 lb	$48
Spelter, cents per pound	7.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

June 27.—Copper is inactive but easy. Lead is quiet and lower. Zinc is stagnant but easier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
June 21	59.25	35.62	May 16	60.41	34.42
" 22	58.75	35.37	" 23	58.93	33.46
" 23	58.50	35.12	" 30	58.15	33.60
" 24	58.25	35.00	June 6	57.68	33.75
" 25	58.62	35.25	" 13	58.39	35.29
" 26 Sunday			" 20	58.77	35.18
" 27	58.75	35.12	" 27	58.69	35.25

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	....	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
June 21	12.75	May 16	12.50
" 22	12.75	" 23	12.89
" 23	12.75	" 30	13.25
" 24	12.62	June 6	13.08
" 25	12.62	" 13	12.91
" 26 Sunday		" 20	12.85
" 27	12.62	" 27	12.68

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	....	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
June 21	4.40	May 16	5.14
" 22	4.35	" 23	5.10
" 23	4.30	" 30	5.02
" 24	4.30	June 6	4.90
" 25	4.30	" 13	4.75
" 26 Sunday		" 20	4.47
" 27	4.30	" 27	4.32

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.00	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	....	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	....	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
June 21	4.95	May 16	5.41
" 22	4.90	" 23	5.35
" 23	4.90	" 30	5.25
" 24	4.85	June 6	5.17
" 25	4.85	" 13	4.98
" 26 Sunday		" 20	4.95
" 27	4.85	" 27	4.88

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	....	Dec.	8.00	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
May 31	50.00	June 14	50.00
June 7	50.00	" 21	50.00
		" 28	48.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	58.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	....	Dec.	95.00	52.50	....

A FIVE BILLION DOLLAR BUDGET

Six months ago the Democratic Secretary of the Treasury was criticized for proposing a new budget of $4,653,856,769. But on the basis of Secretary Mellon's latest estimates the budget for the new fiscal year will exceed the old administration's proposal by over $400,000,000, according to 'The Index', published by the New York Trust Co. The new estimates disclose a rate of spending practically five times as great as the expenditure in 1914.

There may possibly be something to be said in extenuation of the large army and navy appropriations, while other costly legacies of the World War cannot yet be eliminated. But it would seem to be within the ability of an able administration to economize more effectively in an item of civil expenditure that is now running three times larger than in pre-war days.

Receipts and disbursements in the fiscal year 1914 compare as follows with Secretary Mellon's estimates for the new year, beginning July 1:

Receipts	1914	1922
Customs	$292,320,000	$300,000,000
Corporation excise	10,671,000	.....
Individual and corp. income and profits taxes	60,709,000	2,350,000,000
Miscellaneous taxes	308,661,000	1,350,000,000
Sale public lands	2,571,000	1,500,000
Miscellaneous receipts	59,740,000	546,143,000*
Postal revenue	287,934,000	500,000,000†
Total receipts	$1,022,606,000	$5,047,643,000
Disbursements		
Civil and miscellaneous	$364,186,000	$1,201,628,000
War Department	173,522,000	569,750,000
Navy Department	139,682,000	545,225,000
Public debt interest	22,862,999	975,000,000
Postal expenditures	283,558,000	543,512,000
Shipping Board	.....	124,200,000
Panama Canal	34,826,000	10,000,000
Debt redemption	109,000	421,354,000
Bank note cancellation	6,949,000	130,000,000
Railroads	.....	545,206,000
Total disbursements	$1,025,694,000	$5,065,875,000
Total receipts	1,022,606,000	5,047,643,000
Deficit	$3,088,000‡	$18,232,000

*Includes $255,026,000 anticipated interest on foreign obligations held by the United States Treasury.

†Arbitrary estimate, the same amount being added to the net estimated deficit to arrive at total disbursement

‡In 1914 the sale of $3,118,000 bonds not included in receipt above left and actual surplus of $28,000,000.

MONEY AND EXCHANGE

Foreign quotations on June 28 are as follows:

Sterling, dollars:	Cable	3.77⅛
	Demand	3.78
Francs, cents:	Cable	8.12
	Demand	8.14
Lire, cents:	Demand	4.98
Marks, cents		1.42

Eastern Metal Market

New York, June 22.

Improvement of any consequence is difficult to find in any of the markets and prices in some are lower.

Buying of copper is no better and the little business going is being taken at concessions.

The tin market is quiet and fairly steady.

There is little demand for lead and prices are lower.

The zinc market is stagnant as to buying but steady as to prices.

Antimony is a little softer.

IRON AND STEEL

In many lines of steel consumption business seems to have adjourned for the summer, but meanwhile liquidation of steel products in the hands of users is proceeding in a most unusual way. Practically all large manufacturing consumers have turned jobbers and are selling bars, plates, structural shapes, or whatever they have on hand, at prices close to the warehouse basis, says 'The Iron Age'. Thus while the mills are being called on for less steel than at any time this year, the process of 'cleaning-up' all accumulated rolled products is going on, against a day when the country will be more nearly bare of steel than in many years.

The operation of blast-furnaces and steel works is slightly below the rate of last week. In the past two months the Steel Corporation's ingot production seems to have fallen off more relatively than that of the leading independent companies. The Carnegie Steel Co. has blown-out another blast-furnace and now has only 14 in operation out of 59.

There is no longer any strict adherence to the prices announced by the Steel Corporation as effective April 13. Reports have gone through the trade that a formal announcement of lower prices would be made July 1. However, market developments appear to be making any such formality unnecessary. All producers are meeting competition as it develops.

COPPER

Sentiment in this market varies according to the interest interviewed. In some quarters, gloom is apparent while in others a fair business is reported, but in much reduced volume as compared with May. One interest reports continued orders in moderate volume from Germany, France, and some other countries, but almost none from Great Britain, due to the coal strike. Domestic buying is flat though reports from some sections early this week were to the effect that manufacturers using copper were fairly busy. Most of the large producers of electrolytic copper do not quote June-July delivery under 13.25c., delivered, with some as high as 13.50c., but there are a few sellers who are taking the business offered at as low as 13c., delivered, or 12.75c., New York. Reports of sales of small lots at 12.75c., delivered, or 12.50c., New York, are not confirmed. Lake copper is quoted about the same as electrolytic, depending on the seller.

TIN

The week for the most part has been a quiet one with trading between dealers light and with consumers doing very little buying. One June 15 it is estimated that about 200 tons of future shipment metal was sold at around 30c. The course of the market has been but little changed from that prevailing for some weeks—those wanting to buy have had difficulty in securing the metal at the time and when sellers have been ready to do business there have been few buyers. Spot Straits, New York, has hovered around 29 to 30c. during the past week with the quotation yesterday at 28.75c. The London market has declined during the week with quotations yesterday about £3 per ton below those a week ago, spot standard being quoted at £164 10s., future standard at £167 5s., and spot Straits at £165 5s. Arrivals thus far this month have been 930 tons with 2000 tons reported afloat.

LEAD

Stagnation is reported with no business and no inquiries reported either by big or little producers and sellers. The leading interest continues its quotation at 4.50c., New York and St. Louis, but in the outside market it is possible to buy without difficulty at 4.20 to 4.25c., St. Louis, or 4.40 to 4.45c., New York. One seller reports that the trade feels that lead will not go lower unless foreign conditions force the market down. American conditions do not warrant a decline. Production is not large and stocks are light with the statistical position the strongest of any of the metals.

ZINC

This market is also stagnant and has been for some weeks, but it is steadier than the lead market as to prices. The bottom for some time has been 4.45c., St. Louis, or 4.95c., New York, for prime Western for early delivery, but sales have been few and confined to small lots for prompt delivery and to only a few producers as sellers. Offerings to buy at 4.40c., St. Louis, are reported as fairly numerous, but there are practically no sellers at this level. It is possible that 4.45c., St. Louis, is also the bottom of the zinc market.

ANTIMONY

The market is quiet and easier at 5.12½c., New York, duty paid, for wholesale lots for early delivery, with the probability that 5c. could be done under favorable circumstances.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, for early delivery are quoted by the leading producer unchanged at 28c. f.o.b. plant, while the same grade from other sellers is obtainable at 22.50 to 23.50c., New York.

ORES

Tungsten: There is no interest on the part of consumers and the market is quiet and nominally unchanged at $3.25 per unit for Chinese ore and $4 per unit for Bolivian and other high-grade ores.

Ferro-tungsten is unchanged at 48 to 58c. per pound of contained tungsten in lump form, guaranteed as to quality. Other grades are lower.

Molybdenum: Conditions are unchanged and the market is nominal at 50c. per pound of MoS_2 in regular concentrate.

Manganese: There is no demand. Quotations are nominal at 22.50c. per unit, seaboard, with the probability that this can be shaded. Imports continue heavy at over 54,000 tons for May or over 60,000 tons per month for the 11 months ended with May.

Manganese-Iron Alloys: Absolute stagnation features the demand for ferro-manganese and spiegeleisen. Prices for the former are nominal at $75 per ton, Atlantic seaboard, for the British alloy, with the American obtained at $80, seaboard, from first hands and perhaps lower for re-sale alloys. Spiegeleisen is nominal at $30 to $32, furnace.

Of 40,256,030 lb. of refined copper exported during April, 999,358 lb. went to Belgium, 10,800,273 to France, 15,837,896 to Germany, 223,915 to Italy, 1,166,600 to the Netherlands, 7,976,634 to the United Kingdom, 1,541,713 to Canada, and 1,709,641 to other countries.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.50 to 2.00
" " " " " carboys "	2.60 to 3.10
" " C. P., 9 lb. bottles, in barrels, per pound	0.27
" " " bulk, in carboys, per pound	0.22
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottle, in barrels, per pound	0.32
" " " bulk, in carboys, per pound	0.25
" nitric, com'l, in carboys, per 100 lb	9.00 to 9.50
" " C. P., 7-lb. bottles, in barrels, per pound	0.39
" " " bulk, in carboys, per pound	0.32
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.50 to 6.50
" powdered, in barrels "	5.75 to 6.60
" glass, ground, 30 mesh, cases, tin lined, per 100 lb	18.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	0.31
Lead acetate, brown, broken casks, per 100 lb	18.50
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per ton	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO_2, — ¾% Fe), in casks, per ton	140.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.18½
" " " " granular " "	0.18½
" " " " powdered " "	0.19
" carbonate, calcined, in barrel lots, per lb	0.25
" permanganate, in drums, per pound	0.70
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.50
" bicarbonate of " "	4.00
" caustic, ground, 98% " "	6.50
" " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft	393.00
Conduit, galvanzed iron, ¾ in., per 100 ft	12.40
" " " 2-in. "	39.20
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	19.45
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	22.00
" " " 14, single-braid, rubber-covered " per 1000 lb.	8.00
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" " porcelain, 6600 v., No. 44, per 100	21.50
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.00
" " " 3½ " "	64.50
" tubes, 5/16 by 3-in. "	11.65
" " ½ " 6-in. "	42.15
Sockets, weather-proof, molded, No. 60,666, per 100	31.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb	10.25

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.25
" gelatine " " "	19.25
" amnionia " " "	18.25
Fuse, common, in case lots, per 1000 ft	8.50
" waterproof, triple tape, in case lots, per 1000 ft	10.54

FUELS

Coal, Utah steam, $4 at mine, plus $7.50 freight to California terminal points, in carload lots, per ton	11.50
Coal, blacksmith's, in carload lots, per ton	24.00
" " in small lots, per ton	27.00
Coke, in carload lots, per ton	26.00
Fuel oil, per barrel	1.75
Diesel oil, per gallon	0.06½
Distillate " "	0.16½
Gasoline " "	0.24½

HARDWARE

Anti-friction metal, per pound	0.24
Babbitt, genuine "	0.54
Brass sheets, half-hard and soft, per pound	0.30½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅜ by 2-in., per 100 lb	9.30
Nails and spikes (20d to 60d base), per keg	5.25
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	11.25
" cold punched " "	13.20
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	18.00
Track spikes, per 100 lb	6.10

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	4.35
Rails, steel, 8 to 25-lb., per 100 lb	4.60
Reinforcing-steel, per 100 lb	4.35
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	7.80
" flat " " " "	7.70
" flat, black iron " "	6.90
Structural T's, channels, angles, and beams "	4.35
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	7.50
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	13.80
" " galvanized " " "	17.20
" " black " 4-in. "	61.05
" " " extra strong " "	116.75
Shafting, cold-rolled (2¼ to 3-in. base) "	6.25

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 17½%; extra strong cast-steel, 25%; plow-steel, 30%; blue-centre steel, 15%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.42½
Cast-steel rope, per foot	0.25½
" " extra strong, per foot	0.28
Plow-steel rope, per foot	0.30

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	90.00
Fir, common, base price, per M	30.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	36.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	100.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	90.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M	200.00
White pine " " " "	180.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb. cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.25
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.15
" " " 2 (standard), per pound	0.14
Packing, flax, per pound	0.50 to 1.00
" sheet "	0.35 to 1.00
" steam or water, first grade, per pound	1.00
Silex lining, crated, per long ton	35.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	30.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.50
" sheet, 36 in. by 84 in., in tons lots, per 100 lb	14.50

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1,000, in carload lots	60.70
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	3.25
Portland cement, in bags, per barrel of 380 lb	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	12
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 7c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump, white, per ton	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn	5
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE CAPACITY OF MARCY BALL-MILLS

On the front cover of the 'Mining and Scientific Press' of June 4, 1921, there appears an advertisement for the Mine & Smelter Supply Co., in which is an illustration of 18 Marcy ball-mills installed in the concentrator at Braden, Chile. The statement is made that "Eighteen Marcy ball-mills in this installation are crushing about 600 tons per 24 hours for table concentration. The feed is 30% plus one inch". No well informed metallurgist could possibly misinterpret this statement; the excellent performance of the Marcy mill is too generally known to permit misunderstanding. Obviously, however, the statement would be more precise if the word 'each' were inserted after "are" so as to read ". . . are each crushing about 600 tons per 24 hours . . .".

THE SULLIVAN 'TURBINAIR' HOIST

The Sullivan 'Turbinair' hoist meets the demand for a small, compact, but powerful, portable hoisting engine, for use in mines, quarries, yards, and shops. The 'Turbinair' hoist may be mounted on a cross-bar or column in a shaft, winze, or raise, for handling drills, steel, or timbers; it may be bolted to a timber or girder or to a wall or floor, for pulling cars, piling lumber, and any odd jobs of hoisting or hauling. Its capacity is from 1500 to 2000 lb. dead load lifted vertically at 100 ft. per minute, under an air-pressure varying from 50 to 75 lb. The 'Turbinair' hoist weighs 285 lb. and its drum will accommodate a maximum of 500 ft. of $\frac{5}{16}$-in. wire rope. Mine superintendents, foremen, and miners have expressed their surprise and satisfaction at the ease of operation and control of the 'Turbinair' hoist, and at its great pulling power.

The machine is novel in design, but exceedingly simple in construction. It consists of a cylindrical drum, mounted on a steel frame that completely encloses the operating mechanism. This comprises a Sullivan 'Turbinair' motor, and reduction gearing, which drives the drum-shell. The motor is a copy in miniature of the 'Turbinair' motor used with such success for several years past in driving Sullivan compressed-air 'Ironclad' coal-cutters. The two cylindrical rotors are provided with right- and left-hand helical flutes or vanes converging to a spur tooth in the centre. The two rotors mesh together as they revolve under the influence of the incoming air. This motor develops a high starting torque, is economical of power, as it uses the air expansively, and has shown long life and sustained efficiency. 'Turbinair' coal-cutters are in use which have required no repairs in a period of five years.

The hoist is provided with a friction-clutch and brake. When both of these are released the rope may be pulled freely from the drum. The friction-clutch may be locked in position and the load raised or lowered, controlled entirely by the throttle-valve. The brake is of the band type and is of sufficient strength to hold any load within the capacity of the hoist. It works smoothly, thus putting no unnecessary stress on mechanism or rope.

The air is admitted at the axis of the drum through a hollow shaft, and the motor revolves with the drum. Ball-bearings are employed, and all mechanism is totally enclosed and well lubricated. The rotors are lubricated by an automatic oiler. The hoist is quiet in operation, an important factor when signals and instructions are being transmitted. The Sullivan company feels entire confidence in recommending the 'Turbinair' hoist for any duty for which portable-

Sullivan 'Turbinair' Hoist Set for Hauling an Ore-Scraper

One of the Two Rotors Used in the 'Turbinair' Hoist-Motor

column air-hoists have been used in the past; with increased factors of operating convenience, economy, and power.

Details of 'Turbinair' Hoists

Capacity at 80-lb. air-pressure (vertical lift), lb.	1500-2000
Speed at maximum load, ft. per minute	100
Weight (net, less rope), lb.	285
Horse-power	4½-6½
Overall length, in.	22
Overall width, in.	13½
Overall height, in.	15¾
Drum, diameter, in.	9½
Drum, length, in.	9½
Capacity of drum, ft. ⅝-in. wire rope	500
For column, diam., in.	4½
Hose or pipe connection, in.	¾

Equipment included: two column-clamps, one automatic oiler, one throttle-valve, four hose-clamp bolts with nuts and washers, three wrenches, and one oil-can.

TRANSPORTATION IN ALASKA

By E. M. Lagron

Freight-rates which have been absolutely prohibitive in interior Alaska will soon be reduced from $350 per ton to approximately $25. This will result in a flat saving of $325 over the prevailing prices. It is a direct result of the advance of the new government railroad. The new rate will be effective, it is believed, with the completion of the railroad which extends from the tide-water to the interior.

Increased activities will result and mining machinery can soon be shipped to Fairbanks, Nenana, Fort Gibbon, Ruby, and other interior points. At present most of the freight to these places is sent by dog teams or 'mush' over the trails from the seaport towns of Valdez and Cordova.

One of the most marked improvements in transportation will be found in the big powerful 'caterpillar' train which operates on a 60-mile haul. These tractors are manufactured by the Holt Manufacturing Co., and are the same as those supplied the allied governments during the War. They carry about 50 tons of perishable foodstuffs and supplies over the snow and ice. Government engineers have been astonished at the remarkable ability of these tractors to operate at times with the thermometer at 40° below zero.

The recently perfected radiator frost-pad which protects the motor of the tractor, enables the outfit to operate regardless of weather conditions. Another engineering asset of this particular machine will be found in the articulated roller-frame and the equalizer-bar which join the two portions of the tractor-truck and supporting-roller. This latter factor enables the tractor to conform to the unevenness of the ground and to climb over obstacles and yet assures perfect traction without slipping. It is one of the refinements and modifications made possible by war experience.

GIANT NON-FREEZING POWDER

Once every few years one or another of the leading powder companies puts on the market an explosive that is slightly different from the other kinds previously produced. The differences are usually manifested in a small change in one or more of the properties of the explosive. There has been a recent production, however, of a new explosive which is fundamentally different from other dynamites on the market. A new formula and different ingredients are used in its composition. In addition to its non-freezing properties the explosive has another important feature which makes it of especial value to blasters. Other dynamites cause violent throbbing headaches to the persons who use and handle it. This so called 'powder headache' could never be avoided and was always the dread of blasters. Reports have been received stating that the cartridges of the new explosive were handled and loaded without gloves and not the slightest headache was experienced.

COMMERCIAL PARAGRAPHS

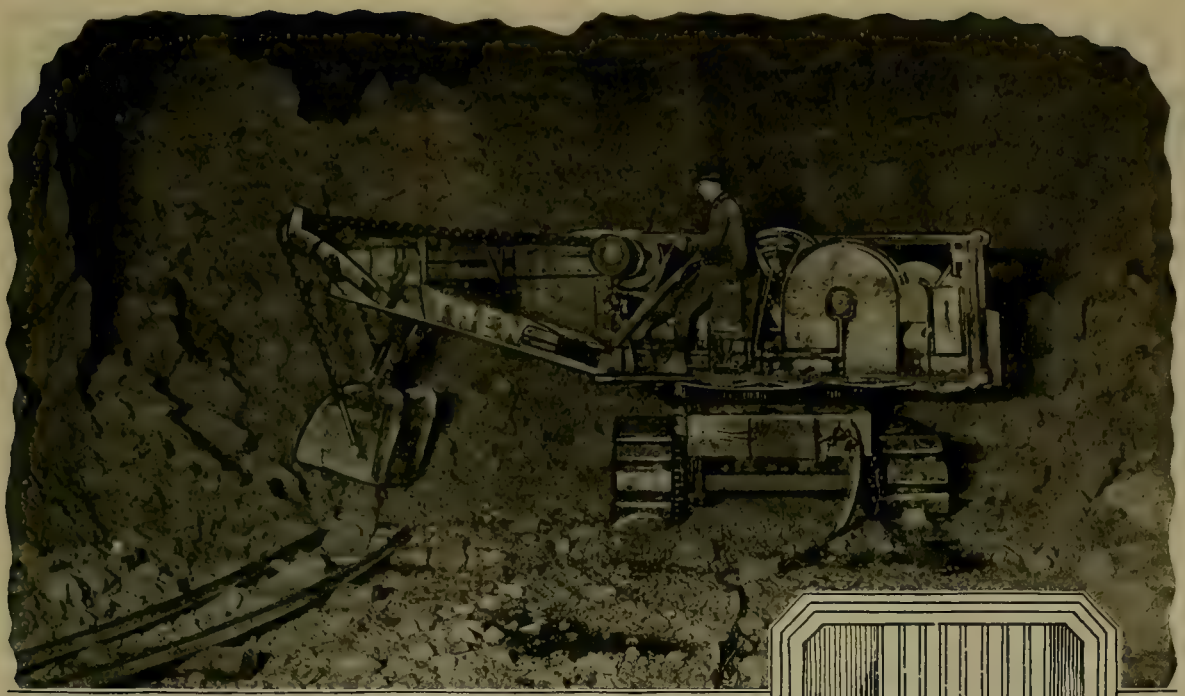
The Dayton-Dowd Co., of Quincy, Illinois, has issued Bulletin No. 244 on type CS single-stage centrifugal pumps. It is now ready for distribution.

The Coast Equipment Co., of San Francisco, has recently been incorporated with the following directors: H. S. Tittle, Robert Dalziel Jr., L. A. Somers, Thomas Harris, and Alfred H. Potbury. L. A. Somers is general manager and Alfred H. Potbury, engineer. The company has offices in San Francisco, Los Angeles, Portland, and Seattle, and represents a number of well-known manufacturers of steam and electric equipment on the Pacific Coast.

An interesting booklet is 'Shaft Sinking', recently issued by the **E. J. Longyear Co.**, of Minneapolis, as Bulletin No. 15. The mining department of the Longyear company maintains an experienced organization capable of handling development problems, whether these be of shaft-sinking, drifting, tunneling, excavating stations and loading-pockets, concreting shafts and workings, or repairing and altering existing shafts or mine openings. Among the undertakings described briefly are the shafts at the Flin Flon mine in Manitoba; the Castleton shaft of the Staso Milling Co. at Poultney, Vermont; the Ankerite shaft, sunk for the Coniagas company at Porcupine; the Wallenberg shaft in Norway; and the Pyne shaft, for the Woodward Iron Co. at Bessemer, Alabama.

The application of the Curtis steam-turbine for driving circulating and boiler-feed pumps and other apparatus has been successfully developed by the **General Electric Co.** The turbine may be designed for either condensing or non-condensing operation. It may be adapted for any steam pressure from 60 to 250 lb., for either dry or super-heated steam, and for speeds from 1200 to 5000 r.p.m. It may be arranged with either one, two, or three stages, depending upon operating conditions. According to Bulletin No. 42,019, just issued, this turbine represents the best type of design and construction, based on practical experience gained in building Curtis steam-turbines. Every detail has been worked out so as to make all parts as simple as possible and of ample size and strength. A description of the principle involved in this turbine, and a careful summary of its several parts, including wheel, shaft, and buckets, wheel-casing, bearings, packing, governor, governor valve, emergency governor, and other elements, is included.

The first public demonstration of the gas-mask, for protection against carbon monoxide, manufactured by the **Mine Safety Appliances Co.**, and in which is utilized the special chemical mixture called 'hopcalite', developed by the U. S. Bureau of Mines and Chemical Warfare Service, U. S. Army, was given the afternoon of May 26 in the special smoke-room of the Bureau at Pittsburgh. In this test two men entered the smoke-room which contained 1% of carbon monoxide gas in the air. One of the men carried a canary bird into the room to indicate to the observers the poisonous nature of the atmosphere. The canary collapsed in 45 seconds, and was immediately removed to fresh air where it was revived with oxygen. While the gas-mask used will give protection in higher percentages of carbon monoxide, 1% of carbon monoxide in the air will kill a man in a few minutes time. The percentage found in working places where there is ventilation usually amounts to considerably less than 1%. One tenth of 1% of carbon monoxide, however, will seriously affect a man who is working and therefore breathing hard in about one-half hour's time, while two-tenths will affect him seriously in about 10 minutes.



Results

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Bulletin No. 29 tells about interesting results obtained by Thew Mining Shovels. Write for your copy.

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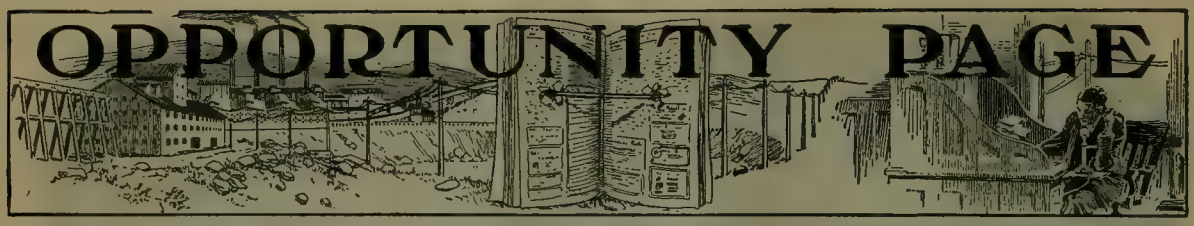

OPPORTUNITIES

Under this heading announcements may be made of new and second-hand machinery or supplies, for sale or wanted. The cost is 5 cents per word, including address. Minimum charge one dollar per insertion. Remittances must accompany order. Copy must be received by Saturday for the following week's issue.

AN ENGINEERS' COLONY is being formed in the hill land west of Healdsburg, Sonoma county, California. An ideal location, land extremely rich, now about six desirable locations available selling from $15 to $40 per acre. Producing the finest grapes and Imperial prunes in the country. An outing country, timber, springs, live streams, game, fishing, postoffice established, Venado, Sonoma county. A chance to make a home while mining is slack. For particulars write to S. Batchellor, Venado, Sonoma County, California. 7-2

FOR SALE, CHEAP—10 stamps, silver-plated copper amgamating plates, 3 Deister slime tables, 50-h.p. hoist, 50-h.p. steam engine, crusher, 1¼-2-4-in. pipe, iron tank 5000 gallons, shafting, etc.; also building. Address Bene, Hogan & McAtee, Nogales, Ariz. 7-2

FOR SALE—90 horsepower C. L. Best tractor, three 10-ton trailers and one 5-ton trailer. All in fine mechanical condition. Make offer. White Auto Company, 1800 So. Figueroa St., Los Angeles, Cal. 7-2

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ENGINEER SALESMAN wants position where long and varied foreign and domestic experience can be utilized by an exporting firm to build up overseas trade. Familiar with heavy machinery, mining, milling and allied industry supplies. Address PW 658, Mining and Scientific Press. 7-23

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ENGINEER AND MACHINIST, also good draftsman; have had experience with steam and Diesel engines, also electricity; can solve any power plant or machine shop trouble; can design anything in power or plants; whether position as engineer or machinist can take charge of plants; prefer Central or South America mining, marine or manufacturing company. Address PW 652, Mining and Scientific Press. 7-9

SUPERINTENDENT OR ENGINEER, technical graduate, 10 years successful experience in mining, milling and examination. Speak Spanish; available on thirty days notice. At present in Mexico. Address PW 651, Mining and Scientific Press. 7-2

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Announcements in this column are secured through the co-operation of many of the largest mining companies in the United States. Advertisements under this heading will be inserted two times without charge. Additional insertions charged at the rate of 2c. per word, including address.

WANTED—Young mining engineer, familiar with metalliferous mining and ore dressing, to teach mining engineering subjects in an Eastern technical school. Salary about $2000 first year. Opportunity for professional work in addition. Address PA 661, Mining and Scientific Press. 7-9

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WANTED—Engineer experienced in installation of electrical and mining machinery; speaking Spanish; temperate climate; contract for one year at $150 per month; extension of contract for two years more if mutually satisfied; traveling expenses and board paid. Send applications to the Colombian Corporation Ltd., Medellin, Colombia, South America. 7-2

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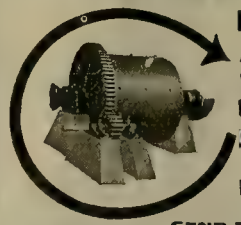
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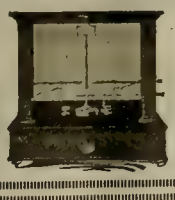

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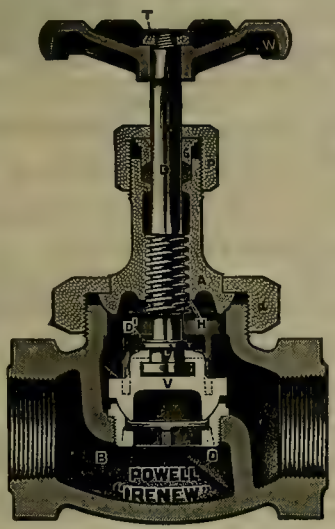

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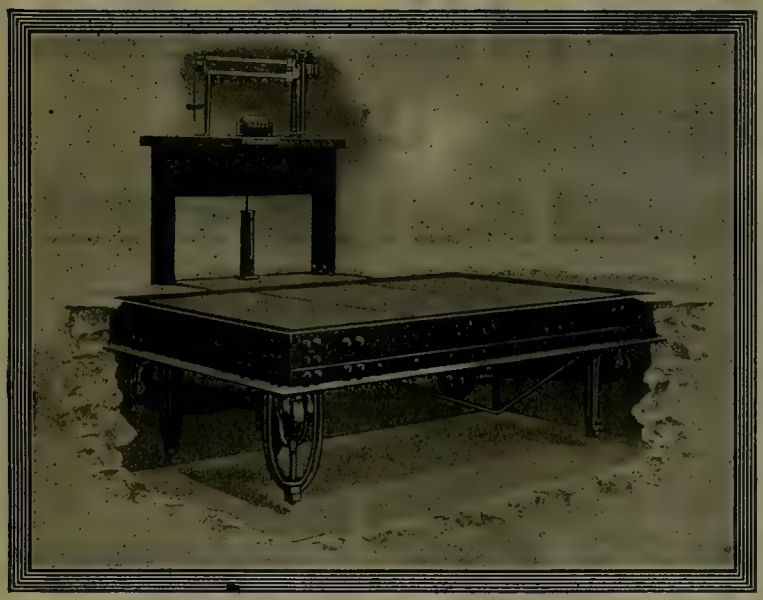

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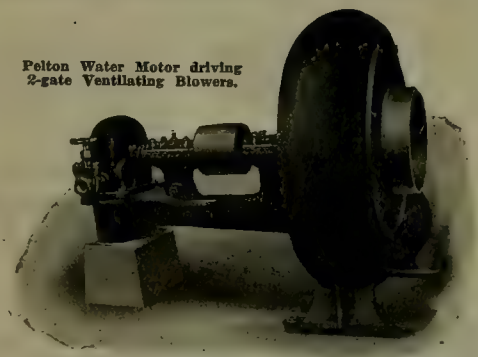

Pelton Water Motor driving 2-gate Ventilating Blowers.

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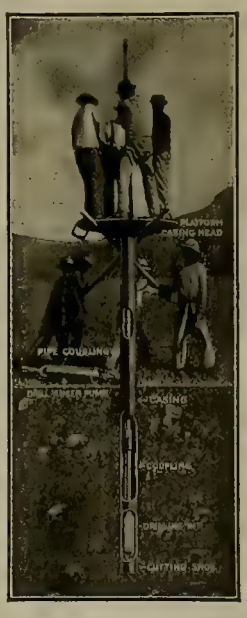

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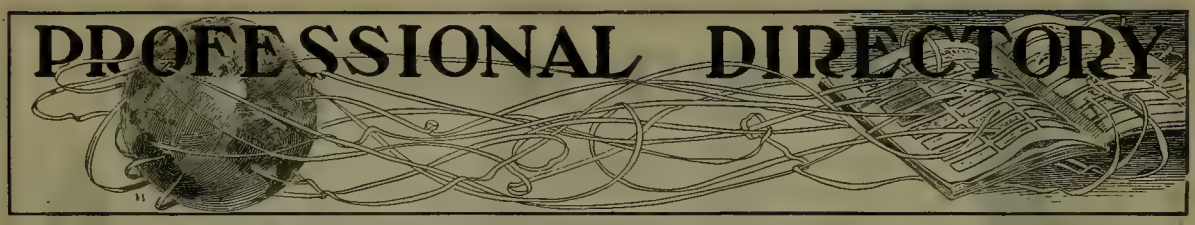

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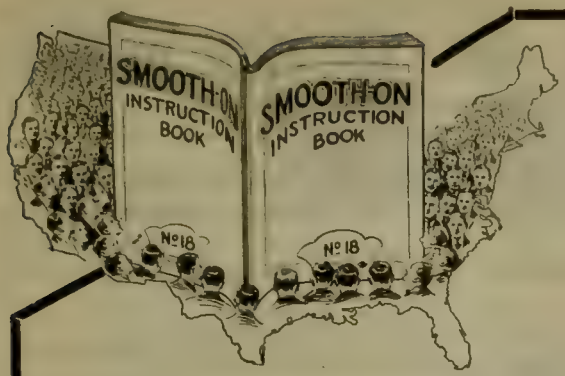

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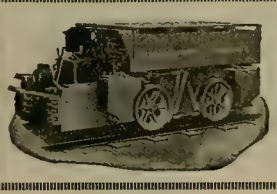

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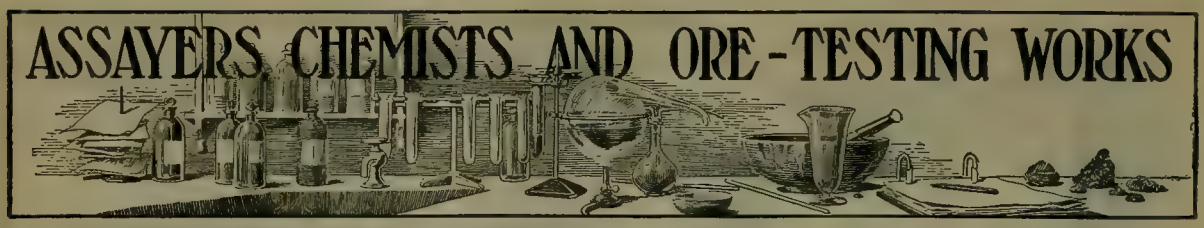

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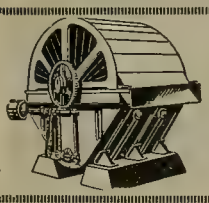

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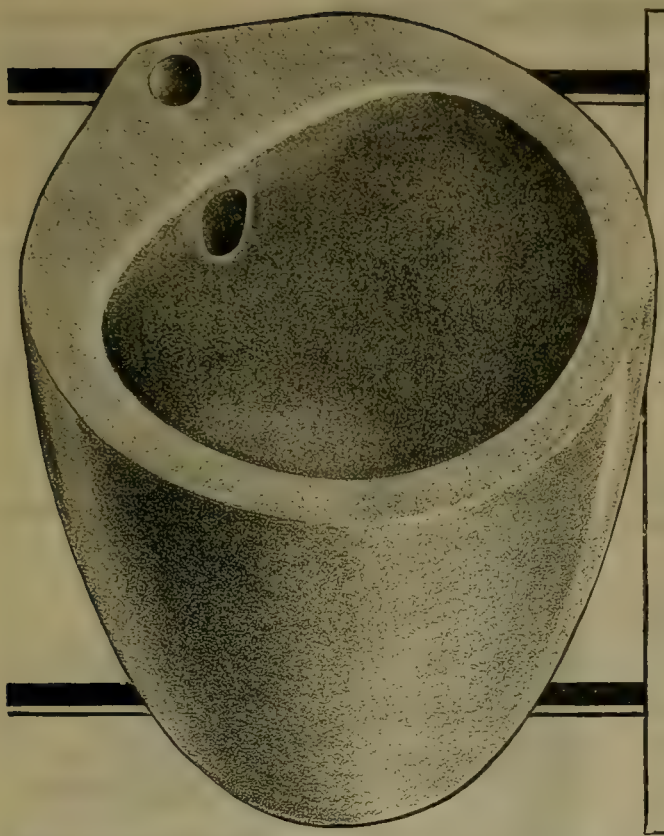
(Continued on page 44)



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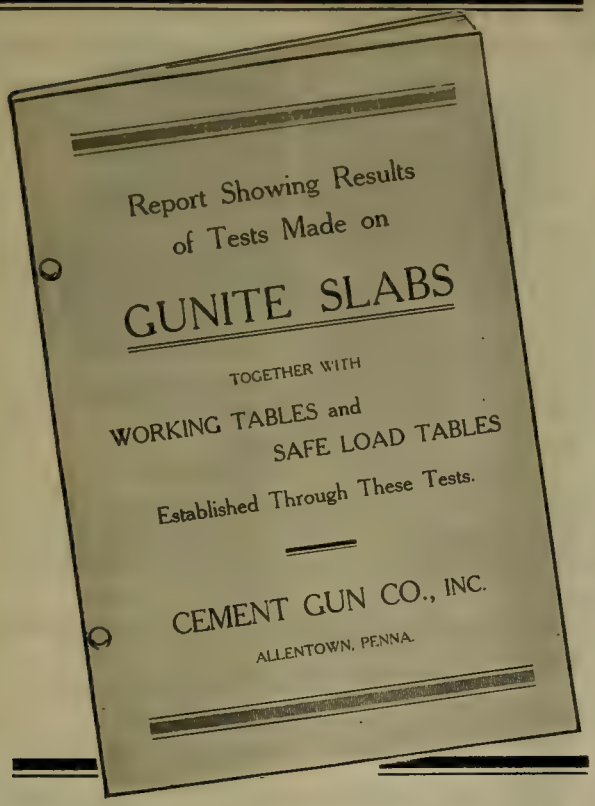

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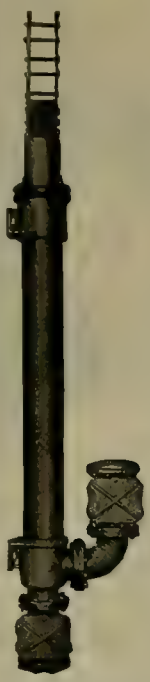

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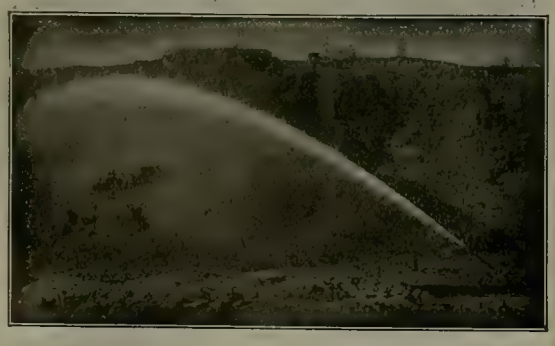

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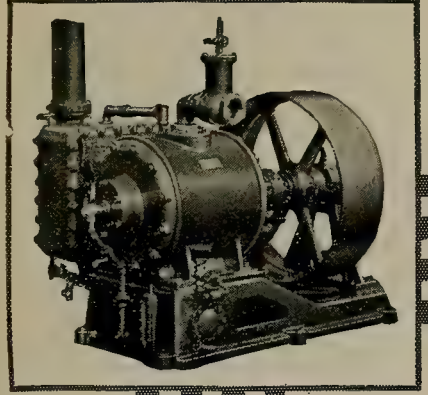

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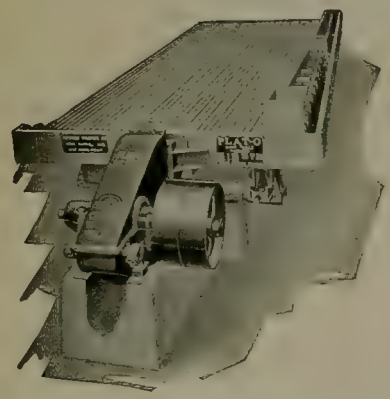

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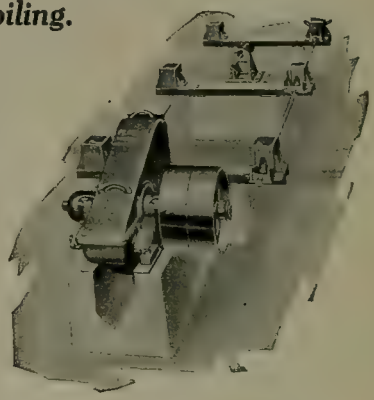

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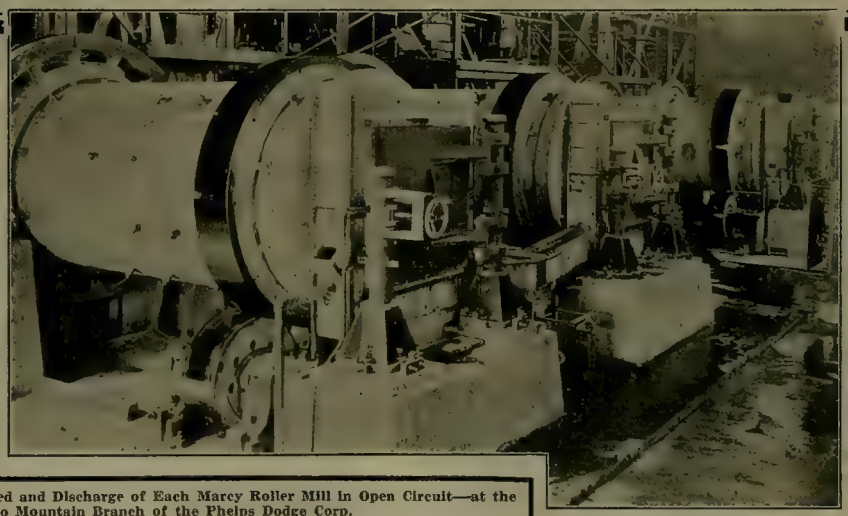
Marcy Roller Mill—Performance Data



Marcy Roller Mills, Phelps Dodge Corporation, Burro Mountain Branch, Tyrone, New Mexico

Screen Analyses of the Feed and Discharge of Each Marcy Roller Mill in Open Circuit—at the Burro Mountain Branch of the Phelps Dodge Corp.

Mesh	Reciprocal of Diam.	Feed		Discharge	
		% Weight	% Wt. Cuml.	% Weight	% Wt. Cuml.
On 2" diam.	0.40	.25	.25		
1½" "	0.57	1.10	1.35		
1" "	0.80	4.28	5.63		
½" "	1.33	3.92	9.55		
4 mesh	2.88	24.00	33.55		
6 "	6.33	12.08	45.63		
8 "	8.92	8.62	54.25	1.00	1.00
10 "	12.66	7.58	61.83	2.40	3.40
14 "	17.84	7.10	68.93	5.20	8.60
20 "	25.33	6.02	74.95	9.60	18.20
28 "	35.70	4.50	79.45	11.80	30.00
35 "	50.50	4.30	83.75	10.60	40.60
48 "	71.40	3.43	87.18	8.80	49.40
65 "	101.00	3.22	90.40	8.40	57.80
100 "	142.8	2.80	93.20	7.40	65.20
150 "	202.0	2.53	95.73	6.00	71.20
200 "	285.6	1.92	97.65	5.00	76.20
−200 "	454.5	2.33	100.00	23.80	100.00
		100.00		100.00	

Energy Units 4082 17324

R. M. E. equals $\frac{13242 \times 1026}{150.3 \times 100}$ equals 904

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Each 6 x 12 Marcy Roller Mill takes crusher discharge of 1¼% plus 1½ inch ring at a rate in excess of 1000 tons per 24 hours, with a power consumption of 2.62 kilowatt hours per ton of feed.

The screen analysis shown above is a remarkable record of Marcy Roller Mill efficiency.

Marcy Roller Mill success is due to the thorough study and great cost expended in its development. In addition to the **open end feature,** the Marcy Roller Mill operates with a low pulp line, which is more effective than if the mill is half full of pulp which necessarily reduces the relative weight of the rods for effective work—the net result being greater capacity.

Write for Bulletin Describing the Marcy Roller Mill

The Mine and Smelter Supply Co.

Denver *Salt Lake City* *El Paso*

New York Office, 42 Broadway

Chicago Representative:
J. R. Mougin, 4555 Malden St., Chicago, Ill.

San Francisco Representative:
M. H. Carpenter, 3151 Eton Ave., Berkeley, Cal.

T. A. RICKARD, • • • • Editor

HOW the world's business is interlocked is suggested by the fact, among others, that the export trade in copper fluctuates with foreign exchange. When the dollar is at an excessive premium, our foreign customers cannot afford to buy our copper.

EFFORTS to end the flotation tangle by the purchase of the Minerals Separation company's numerous American patents have failed, owing to a wide difference between the price demanded and that which the leading copper operators were willing to pay.

THE War taught us to think in billions of dollars, but Russia is inaugurating a new era in finance. In that distressful country ruble notes are now being issued by the trillion. For the first four and a half months of the present year the amount aggregated 1,168,000,000,000 rubles, as against 225,000,000,000 for the same period last year.

ON another page we publish a short article on 'Conditions in Europe' as seen by Mr. Lewis W. Douglas, who has returned recently from the other side. It is a pleasure to publish this article, because, among other reasons, the author of it is the son of Mr. James S. Douglas and the grandson of James Douglas. Evidently the tradition of good citizenship is being maintained.

TIN from the Far East is sent to Pittsburgh, and then comes back to California, as tin-plate, for use in the canning of our domestic products. The Yukon company has evolved an ambitious scheme for the development of immense tin properties in the Federated Malay States; just now the company is the mainstay of the industry in that part of the world. If the tin could be smelted in California and the plate fabricated near-by, the cost of containers could be reduced considerably.

PROSPECTING by aeroplane would appear to be considered a rapid and healthful method of searching for oil in tropic countries. We learn that a company has acquired concessions from the government of Venezuela that will permit it to prospect the unexplored region in the delta of the Orinoco. The district is rugged and the vegetation is dense, so that ordinary prospecting would be dangerous and expensive. Lack of vegetation will be taken as an index to the presence of oil, so that landing will be unnecessary for the preliminary reconnaissance. Sea-planes will be used.

SILVER producers in Mexico appreciate the attitude of the government of that country with regard to the reduction of taxes on metals exported. Below 60 cents per ounce there is no tax; when the market price rises above that amount, a graduated levy is made, which is of reasonable proportions, as compared with previous demands. One American company that operates in the State of Sonora reports a saving of about $9000 per month on this account.

SENATOR KING, of Utah, has introduced a bill amending the Revenue Act so as to exempt gold-mining companies from the payment of the tax on their net income. This seems to us a reasonable thing to do, considering the hardships under which the gold-mining industry suffered during the War, when other branches of the mining industry prospered exceedingly. If gold mining is to be helped, the remission of the tax on income seems fair enough.

THE discontinuance of the practice of publishing, in the monthly bulletin, a condensed statement of the education and professional experience of intending members of the Institute, has deprived the profession of a source of biographical information; it is now no easy matter to obtain quickly any information as to the professional standing or activities of our confreres; but we are glad to see that the John W. Leonard Corporation, of Brooklyn, New York, has taken the initiative, and that a 'Who's Who in Engineering', containing about 10,000 records, will be published early in September. Engineers are timid of publicity; but it is time to realize that this attitude does not inspire public confidence. The new book, provided the members of the engineering professions agree to co-operate by sending in their records, should prove useful and interesting.

OPINIONS differ in regard to the pronunciation of some words. Mr. Ellwood Hendrick, in a review of a recent book on chemistry, regrets that the author did not enlighten him as to the correct pronunciation of the word 'pyrites'. Chemists make the word sound like

'pright-ease', he says; metallurgists in increasing numbers refer to the mineral in words that are reminiscent of 'pie-rights'. Our solution of the problem would be to discountenance the orgy of unnecessary pluralization that too often disfigures technical literature. In the book that Mr. Hendrick reviews we read that, "When native sulfur or metallic sulfide ores (pyrites) are roasted, they burn to the lower oxide of sulfur (SO_2)". Reduced to simple language, and aided by the use of customary spelling, this means that, when native sulphur or metallic sulphide ore (pyrite) is roasted in the air, it burns to the lower oxide of sulphur. The avoidance of the plural will solve the problem of pronunciation.

TWO factors may be cited to account for the large increase ($40,000,000) in savings-bank deposits in New York during the first three months of the year—during a period of so-called industrial depression. They are the economic effects of prohibition, and the tendency of so many of the people to wait for the time when the dollar will have regained most of its pre-war value as a purchasing token, so that they may be able to buy as they did before the retailer named his own price and virtually told his customers to "take it or leave it". Several mining companies are keeping intact their balances of ore-reserves, and even adding to them, because metal prices are so low that unprofitable operation would result from the maintenance of the normal output. If the nation's reserves of capital and ore are to be taken as evidence, then we are undoubtedly in a more prosperous condition than is generally admitted, for 'prosperity' is not synonymous with 'spending'. When a readjustment of prices occurs, this real prosperity will be felt by all classes of the community.

INDIA'S influence on the market for gold and silver is not always realized; but, as Samuel Montagu & Company point out, a country with a population of over three hundred million persons with the hoarding instinct is likely to affect prices to a considerable degree. The last census of India revealed a reduction in the rate at which the population had been increasing. In the first decade of the century the gain was 7.1%, and in the second, only 1.2%, an increase of less than half that of the last decade of the 19th century, when the country was visited by two great famines. The influenza epidemic, which took a toll of 6,000,000 lives, left many in an enfeebled physical condition. This will account, to some extent, for the lessened ratio of increase in population during recent years. However, the financial gain, arising from the fact that Indian commodities were being exported at higher prices during and immediately following the Great War, more than offset the lessened increase of earning capacity, due to decreased numbers. For the fiscal year 1913-1914, there was a balance of trade against India amounting to 1202 lacs of rupees; for the period 1919-1920 the balance was in favor of the country, and to the amount of 9533 lacs. This remarkable reversal of economic conditions, taken in conjunction with the idiosyncracies of the Oriental in the matter of choice of gold or silver for a reserve fund, indicates how it is that India exercises such an important influence on the bullion markets of the world.

STOCKS of crude petroleum in the United States on May 31 were 155,341,000 barrels, equivalent to 115 days supply at the current rate of consumption. This breaks all existing records. Likewise the total domestic production for May, 41,920,000 barrels, exceeds that of any previous month, although the value of the oil at the wells was only 66 million dollars as compared with 113 million dollars for the 36,503,000 barrels produced during May 1920. This reflects the precipitous decline in the price of crude oil since the first of the year. Imports from Mexico have continued in large volume, despite the prevailing high export-duty that is now the subject of diplomatic discussion between our Government and that of Mexico. The monthly imports from Mexico up to June 1 averaged 11,000,000 barrels, or at almost double the rate of the corresponding period of last year. Oil production cannot be curtailed suddenly, and the only remedy for overflowing tanks and pipe-lines is to stimulate sales; this has been done by cutting the price of crude oil. On June 15 the Prairie Oil & Gas Company, the chief buying agency for the Standard Oil Company, reduced its price for mid-continental light oil to $1 per barrel; in consequence, production will probably diminish for some time; then, as the stocks decline, higher prices will be restored. The fluctuations give a nice exhibition of the operation of the law of supply and demand, and at the same time emphasize the mistake made by the oil companies in not announcing reductions three months ago; as they now appear to realize, such action would have been profitable in the long run. The return of general prosperity would be hastened if a similar action were taken by those in control of other industries.

COMMERCIAL prosperity in any civilized country depends in large part upon the adjustment of its foreign trade relations. This point is emphasized by the Chamber of Commerce of the United States, which has sent its delegates to the International Chamber of Commerce, meeting in London at this time. The chairman of the American National Committee is Mr. A. C. Bedford, chairman of the Standard Oil Company and American vice-president of the International Chamber of Commerce. The head of the Standard Oil Company must be a man of very unusual parts, for no organization anywhere shows such a spirit of loyalty and efficiency as that of the Standard Oil; it is one of the few super-enterprises that seems to have found men of a character and capacity equal to the responsibilities entailed in the conduct of a worldwide business. The report of Mr. Bedford and his committee recognizes the fact that the United States, having become the principal creditor nation, must be prepared to extend credits on a large scale unless she is willing to face a great decrease of her export trade. Moreover, having changed her status from

a debtor to a creditor nation, she must be prepared to receive imports in larger volume than formerly, "and such an increase may react unfavorably on certain lines of trade". In short, "this problem of the readjustment of foreign trade relations is one of the most important developments that have resulted from the world war". When one reads the opinions of such men as these, and then notes the proceedings of Congress, which is busy gathering stones for a wall of tariffs, one is moved to sardonic laughter.

AGE has not dulled the truth of the old proverb that a man is judged by the company he keeps. We commend it to the gentlemen who are in control of the Bingham-Galena Mining Company; we might add that the prudent investor generally appraises a mining enterprise by the character of the men who are promoting it. Apparently Mr. Harry S. Joseph and his associates in the newly formed Bingham-Galena company, a consolidation of sundry properties at Bingham, Utah, are not particularly concerned with what people think of them, if one may judge from the fact that they have recently taken into partnership the notorious George Graham Rice, an individual to whom our readers neither need, nor probably desire, any introduction. Rice has recently underwritten 467,100 shares of Bingham-Galena stock, notwithstanding a vigorous protest from various reputable investment brokers and representatives of the Utah Chapter of the American Mining Congress at a public hearing before the State Securities Commission. Objection was based solely on the ground of Rice's bad reputation; it was argued that the good repute of the mining industry of Utah would suffer by reason of having his name associated with the enterprise. However, the Commission declined to interfere with the proposed transaction. In the light of the few facts at hand we are inclined to agree that the alternative decision would hardly have been justified; the circumstance that seems strange to us is the persistence of Mr. Joseph and his associates in consummating the deal with Rice in the face of strong opposition. The insistence of the owners seems foolish, especially if their mines are good ones, for they are giving their undertaking a black eye at the start. Well-informed speculators will suspect that the actual value of the mines is slight; there remain the ignorant and greedy, whose hard-earned money supports Rice and his followers. The properties may have merit and the enterprise may become profitable, but, just now, the finger of suspicion points to the contrary.

HOLDERS of stocks and bonds, in times of industrial depression as well as in times of hectic boom, are liable to appraise the value of their securities entirely on the basis of income and selling worth. Mr. R. H. Tingley, in a recent issue of the 'Annalist' gives publicity to the suggestion that money-worth should also be taken into consideration. In other words, the current value of the security, to a greater extent than is realized, lies in the purchasing power of the money that may be received when it is sold. The sponsor of this novel method of appraisal quotes the American Smelting & Refining Company's securities for the purpose of comparison. Between the spring of 1920 and the month of May 1921, the money-value of the stock decreased 22%, and that of the bonds, 11%. By considering the fall in the wholesale prices of commodities during that period, the money-market value of the securities and their purchasing value on this basis, it is estimated that, if sugar were to be bought, the preferred stock has appreciated 134%, and the bonds, 165%; if wheat were to be bought, the preferred stock and bonds have increased in value 73% and 95%, respectively. Between May 23, 1920, and the same date of this year, commodity prices declined 36%. Bond prices advanced, according to Dun's index, by 6%; stocks, on the other hand, declined 12%. By selling a $1000 American Smelting & Refining bond last year one could have bought, with the proceeds, 512 bushels of corn; this year the same transaction would result in the acquisition of 1382 bushels. Stocks and bonds, according to this method of appraisal, are cheap at present prices. The discussion raises the question as to whether stocks will appreciate in price in proportion to a further fall in commodity prices, or is the connection between the two so unstable that a rise or fall in the price of both, at one and the same time, is possible?

COLD-water thawing of frozen ground, preliminary to dredging, is being applied successfully in the vicinity of Fairbanks, according to the report of the Territorial Mine Inspector, Mr. B. D. Stewart. The overburden, at the place where the dredges are operating, averages about 26 feet in depth—about 14 feet of comparatively fine frozen gravel that is overlain with about 12 or 13 feet of 'muck'. The thawing apparatus consists of a manifold of 6-inch steel riveted pipe, and eight outlets to the 'points', which are 26 feet long, and of 4-inch pipe, not constricted at the ends, but discharging full bore. The points are set at 5-foot intervals, and settle, by their own weight, the full depth of 26 feet as the thawing proceeds. Three manifolds were employed this year on Fairbanks creek; and it is reported that the thawing has been accomplished with but a fraction of the expense involved in the use of steam-points. The results compare favorably with steam so far as time is concerned, and surpass it in the thoroughness with which the frost is overcome. In one case, two contiguous blocks of ground were being thawed, one with steam and one with water, the spacing between the blocks being the same in both cases. It was found that between each two steam-points a rib or comb of unthawed ground remained, whereas the block on which cold water had been used was uniformly and completely thawed throughout. The principal essential for the thawing of ground with cold water is an adequate supply of water at a temperature sufficiently above the freezing-point to ensure the melting of the ice. It is also necessary that the ground shall be as free as possible from large boulders, so that the 'points' can settle readily; they are not driven

into the ground. The working temperature of the water used should be about 40°F.; only a slight pressure is necessary. The work is being carried out on the property of the Fairbanks Dredging Company, where two dredges, one of which, made by the Union Construction Company, of San Francisco, has a capacity of 2500 cubic yards of gravel per day. Thus the cold-water thawing process is being proved on a working scale.

The Comstock Meeting

On June 27 and 28 the San Francisco Section of the Institute held a field meeting with the California Dredge Operators at Virginia City, Nevada. The two subjects of immediate interest were the revival of mining on Gold Hill and the dredging in Gold Cañon, both enterprises being conducted by corporations subsidiary to the Metals Exploration Company, which is identified with Mr. Bulkeley Wells and his friends of New York and Boston. An evening session, held at Minden, was devoted largely to papers covering these operations. Mr. George J. Young, Western editor of the 'Engineering and Mining Journal', gave a timely and interesting description of 'Mine Development at Gold Hill', and Mr. Gerald H. Hutton another on 'Dredge Mining Practice'. Sixty assembled at the dinner that preceded this meeting. Mr. Edwin Higgins, vice-chairman of the Section, was in the chair. Mr. Albert Burch read a letter from the president of the Institute, Mr. Edwin Ludlow, in reply to sundry criticisms from the local section, more particularly in regard to the continued publication of the Institute magazine. It was stated that members living in the larger cities did not desire the magazine, but that those stationed in places where news is not so plentiful liked to receive a publication so gratuitous. The local committee on Institute affairs, consisting of Messrs. Burch, Abbot A. Hanks, and Wilbur H. Grant, was requested to consider and report upon the President's communication. Mr. F. W. Bradley and Governor Boyle of Nevada led the discussion on Mr. Young's paper, which gave, in lucid outline, the plan of operations adopted by the United Comstock Mines—the company that is re-opening the Yellow Jacket, Belcher, Crown Point, and other famous mines, covering a length of 7000 feet along the Comstock lode. A new adit is being driven from American Flat to tap the old workings at a depth of 650 feet below the outcrop, in order to reach the lode-matter that was used to fill the old stopes and the ground that the former workers found too poor for exploitation. It is estimated by the engineers of the United Comstock Mines that 3,000,000 tons of $6 material is assured. Of this assay-value, one third is gold at $20 and two-thirds silver at $1 per ounce. It is anticipated that the working cost can be kept down to $3 per ton. Cyanidation, with concentration and separate treatment of the sulphides, will be used for extracting the precious metals. Successful leaching on the Comstock in the past has suffered from the presence of woody fibre and other carbonaceous matter present in the filling and tailing left from former operations, but this obstacle, we are informed, has been overcome entirely in the experimental work done by Mr. C. J. Reid, who is metallurgist to the United Comstock Mines. As to the mining, it is proposed to use finger-raises to tap the old filling, and to supplement this method by top-slicing where necessary. Undoubtedly this is the most interesting technical feature of the enterprise. The old filling has consolidated sufficiently in places to call for the use of explosives; in other places, however, it it loose enough to require cribbing. What the pressure of settling ground can do in a mine is suggested by the fact that a layer of filling 7 feet thick can be squeezed into a layer 2½ feet thick; timbers 10 inches thick can be compressed to 3 inches. The physical condition of the ground in the old workings, whether filling or untouched lode-matter, varies so widely that no fixed system of mining can be applied uniformly. As to the metal contents, these also vary greatly; the existence of blocks of barren ground, of varying shape, will render difficult any scheme of systematic stoping. All this, of course, is perfectly well known to the engineers in charge of the work, and they are prepared to face these minor troubles in due course. The old filling is difficult to sample; so also is the virgin ground that has been shattered unequally by natural pressure; nevertheless, the results of the sampling are believed to have been adequately checked by comparing moil-samples with car-samples, and these in turn with mill-runs. It will occur to the reader that, in such a locality and in such a lode, there are chances of finding pockets of rich ore that were missed by the old-timers. Such chances, presumably, are slim, because the upper horizons have been well explored, not only by cross-cuts but by diamond-drilling. The engineers in charge do not anticipate the discovery of bonanzas within the scope of their venture, but they are confident of the trustworthiness of their sampling and of other basic estimates.

The visitors were taken underground in the morning, and to the dredge in the afternoon. Mr. Hutton, who is in charge of the dredging, did not describe the operations in the paper he read at the evening session; instead, he discussed discrepancies between drilling and dredging in general, quoting figures to illustrate the unaccountable differences that endanger estimates of the results to be obtained from dredging enterprise. His statements were confirmed by Messrs. W. H. Gardner and James W. Neill, both veteran dredge engineers, who quoted from their own experience. No explanation at all convincing was forthcoming, so the principal contributors to the discussion were nominated as a committee to inquire and report on this technical problem, in the expectation that some light would be thrown on the subject. Mr. Higgins asked Mr. Hutton to take the chair during the latter part of the meeting, which closed with a hearty vote of thanks to Mr. Bulkeley Wells and his associates for their hospitality, mental and physical. Next day the visitors went underground in the Consolidated Virginia mine and saw some of the deeper workings, down to 2200 feet. It will be remembered that the deepest work-

ings on the Comstock are in the Union mine at 3350 feet below the outcrop, but the great production that made the lode so famous came, almost entirely, from above the Sutro Tunnel, which cuts the lode at 1860 feet. The biggest bonanza, that of the Virginia and California mines, extended from 1200 to 1750 feet. It was found by James G. Fair when he was acting as superintendent for the adjoining Gould & Curry mine. He found rich ore in a drift that he pushed into the Consolidated Virginia ground, that is, he obtained his information by trespassing. Subsequently he, John W. Mackay, James Flood, and William O'Brien—the 'Big Four'—bought enough shares to win control of the 'Con. Virginia', as it was then called and ever since. For three years, 1874-1877, the Con. Virginia produced $3,000,000 per month and paid dividends at the rate of $1,080,000 per month. In 1876, Mackay, then the superintendent, took out $6,000,000 worth of bullion in one month, in order to make an exhibit at the Centennial Exposition. This rate of production, of course, could not last. It did not. The Comstock flared and went out like a gigantic industrial torch. By 1885 it was decadent. In April 1899, when the present writer made his previous visit, only 150 men were at work, although the population of Virginia City then was about 3000. Now 600 men are at work, although the local community has dwindled to 1500. Today there is a manifest revival of hope and of life. Besides the new operations on Gold Hill, it is likely that a similar resuscitation will be started soon on the upper levels of the so-called middle group of mines, and that within a year there will be several thousand men at work at Virginia City. This re-opening of old and famous mines is of great technical interest because it will show to what extent it may be practicable and profitable to undertake similar operations in decayed mining districts in other parts of the world.

The Outlook for Gold

In reviewing the past operations and future prospects of the Crown Mines group, Mr. Samuel Evans made sundry interesting remarks concerning the demand for gold and its consequent appreciation in value. Mr. Evans was speaking as chairman of the company on the occasion of its annual meeting at Johannesburg; he is known to be an astute and sagacious man; therefore his views regarding the status of gold are worthy of record. He is of the opinion that, whereas the pendulum of prices during the War swung farther in a direction adverse to gold mining than it had ever gone before, it is now swinging back; it may, he thinks, go equally far in the opposite direction, so that there may follow a rise in the value of gold greater than has been experienced since the metal has been used as money among civilized peoples. Mr. Evans bases his belief on the fact that the world's production of gold has decreased 27% since 1915, and on the expectation that "in the course of the next few years" there will be a demand more intensive than at any time since it was established as the standard. He asserts that "the desire for gold among the people of the Far East has been enhanced" during the War and since, and "the use of it for currency purposes both there and in South America has increased". He expects Russia to come back to a gold basis, as France did after the revolution. He believes that Austria and other European countries having paper currencies that have become almost valueless "will be obliged to abandon paper for gold". Indeed, he deems it to be "within the bounds of possibility" that the Crown Mines company may yet find it profitable to mine the 3-dwt. banket of the Main Reef. The ore-reserves of the Crown Mines are estimated at 8,132,000 tons averaging 6.4 dwt. per ton.

Concurrently with these pleasant suggestions from Mr. Evans there is published a report by Mr. H. F. Marriott, consulting engineer to the Central Mining & Investment Corporation, a company holding large blocks of shares in a number of the principal mines of the Rand. Mr. Marriott is an ex-president of the Institution of Mining and Metallurgy and is abundantly qualified to speak as an authority on Rand economics. He gives the following analysis of operations on the Witwatersrand in the last two years:

	1919	1920
Tonnage treated	24,043,638	24,096,277
Revenue	£34,297,431	£33,231,257
" per ton	28.53s.	27.58s.
Expenditure	£27,518,253	£30,814,861
" per ton	22.89s.	25.67s.
Working profit	£ 6,779,178	£ 2,416,396
" " per ton	5.64s.	2.01s.
Premium	£ 3,503,067	£ 8,885,380
" per ton	2.91s.	7.37s.
Total revenue	£37,800,498	£42,116,637
" " per ton	8.55s.	9.38s.
Dividends	£ 5,845,607	£ 8,275,708
" per ton	4.87s.	6.87s.

The tonnage and revenue show but slight variation, whereas the increase of expenditure is alarming, for it has diminished the operating profit by 66%. Indeed, mining on the world's premier goldfield would have worn a sickly look by this time if the 'premium' on gold had not come to the rescue, by increasing the operating profit from 2.01 shillings to 9.38 shillings per ton, and thereby permitting a distribution of dividends equivalent to 6.87 shillings per ton in 1920 as against 4.87 shillings in 1919, that is, an increase of over 40%. In regard to the question of cost per ton, Mr. Marriott quotes the following figures, which he gives in shillings, pence, and fractions thereof; owing to the fluctuations in exchange it is useless to translate them into American currency; we have simplified them by conversion into shillings and decimals.

	Wages			Other	Total	Tons
Year	European	Native	Materials	costs	shillings	milled
1915	4.8	3.9	5.69	3.18	17.57	10,405,000
1916	4.98	4.13	6.08	3.28	18.47	10,156,000
1917	5.59	3.89	6.41	3.78	19.66	9,359,000
1918	6.68	4.23	7.55	3.59	22.06	12,005,000
1919	7.38	4.19	7.86	3.93	23.36	11,267,000
1920	8.53	4.5	8.44	4.41	25.9	11,028,000
December 1920	9.2	4.8	9.2	4.14	27.34	867,000

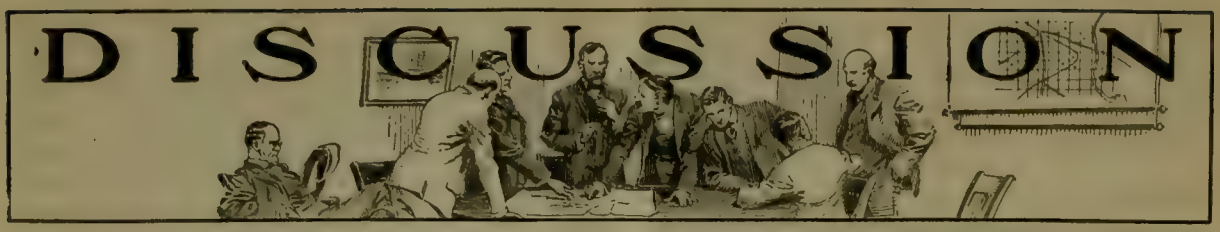
It will be seen that the wages of European employees have increased 92% since 1915; native wages are 18% higher; materials have gone up 61%, and 'other costs' 39%. The enormous advance in European wages, says Mr. Marriott, "is out of all proportion to the remainder of the increases noted, and the anomalous position has been created that the total cost to the industry of the

European employees, who largely act in a supervisory capacity and constitute one-eighth of the total labor force, is nearly double the whole expenditure on the native laborers who carry out the work". These natives —Kafirs—work five hours per day only, and are prevented from becoming bosses over their own people owing to the 'color bar', which restricts supervision to white men. In Northern Nigeria, the employment of native foremen has been started, and it seems likely that a similar step will be taken in the Transvaal. The Chamber of Mines has suggested a cut of three shillings per shift in the wages of the white employees as from July 1, and we shall know soon whether they have accepted. Any adjustment of wages based on the profit made by the companies is rendered difficult by the violent fluctuations in the premium on gold, or, in other words, the value of the United States dollar, for, after all, the premium simply marks the discount on the pound sterling as compared with the standard unit of today—the dollar. It is a new experience for gold miners to find their product so variable in price; the mining operations on the Rand are far more speculative than formerly; the contention, so common twenty or thirty years ago, that the Rand stocks were absolutely sound investments suitable for widows and orphans, is absurd. In the United States, we have seen gold depreciated by the abnormal conditions created by a great war between many civilized nations, but we have escaped the vagaries of a gold market such as obtains in London and Johannesburg today. Already we see signs of a returning appreciation of gold, and a renewal of interest in gold mining. The vaticinations of Mr. Evans may be too rosy for immediate acceptance, but that gold mining will come into its own again in due course we believe confidently.

Claims Against Mexico

Under the title of 'Claims against Mexico', Mr. Raoul E. Desvernine has prepared an excellent little treatise on the various aspects of international law that are applicable to the claims of citizens of the United States, or of other countries, for losses sustained in Mexico during the revolutions that have occurred during the last decade. Mr. Lindley M. Garrison, in a foreword, speaks cautiously of "entangling alliances", but emphasizes the desirability of closer commercial relations between nations and nationals. He contends that we of the United States have shown a reluctance to learn international law, particularly with reference to claims in respect of damage or loss; it is to be regretted that the inclination to confine ourselves to our own interests has led us to neglect the acquisition of knowledge concerning other countries, and of those broad principles of law that underlie international dealings. The size of our country and the rapidity of its development have tended to make us self-centred; extension of foreign trade, however, is causing a change. Mexico, Mr. Garrison avers, seems to be attaining her equilibrium at last, and it is to be hoped that she will soon resume her normal position in the family of nations. Before this is possible, however, she must meet her obligations. The purpose of Mr. Desvernine's book is to elucidate the fundamental rules and considerations that govern the subject of claims, and to show the proper course to be taken in presentation and prosecution, in the hope that an orderly procedure will ensue, and that the demands will be met with fairness and equity. The book is offered by one who has a sincere belief in the possibilities of economic development in Mexico, a development that, unquestionably, is dependent upon a resumption of normal relations with other nations; it is recognized that the country cannot achieve success other than by the aid of foreign capital and foreign resources. Normal relations and normal development will commence only when other nations are satisfied that those of their citizens who hold claims against Mexico are likely to receive consideration and justice.

The essence of the present status of the question is summed up in the fact that, "The Latin-American countries have been the staunchest supporters of the theory of non-responsibility. They have been forced to this stand by the frequency with which they have been visited by insurrections, uprisings and banditry, and have, by necessity, been compelled to develop, through their statesmen and publicists, a justification for their reiterated attempts to deny liability." Mexicans fear that the enforcement of the obligation of international responsibility would lead to the acquisition of economic advantages by the citizens of the interposing nation; loss of sovereignty and independence is dreaded, but there is no justification in modern international law for the repudiation of responsibility. In the new Mexican Constitution of 1917 it is stated: "Only Mexicans by birth or naturalization and Mexican companies have the right to acquire ownership in lands, waters and their appurtenances, or to obtain concessions to develop mines, waters or mineral fuels in the Republic of Mexico. The Nation may grant the same right to foreigners, provided that they agree before the Department of Foreign Affairs to be considered Mexican in respect to such property, and accordingly not to invoke the protection of their Governments in respect to the same, under penalty, in case of breach, of forfeiture to the Nation of the property so acquired." This clause was considered by many Mexicans as one of the triumphs of the revolution that unseated Porfirio Diaz; in the opinion of the United States it is viewed as an indication of a desire to evade international duty, and so is ignored or denied. Mr. Desvernine's book contains an excellent summary of Mexican history from the time of the overthrow of Diaz until the inauguration of General Obregon; he discusses the nature of the successive governments and revolutionary bodies, as well as the liability of the present government for the acts of each, with admirable clarity. From an examination of the evidence it is shown that Mexico is responsible for the acts of all the administrators since the fall of Diaz, except those of Huerta, who was not recognized, in any official way, by the United States.



Prospecting

The Editor:

Sir—As you have invited the prospectors to give their views relative to the so-called decadence of prospecting, I will herewith submit my views.

I went with the rush to Leadville, Colorado, in November '79. I did my first prospecting on the head of the Pecos river, New Mexico, in the summer of 1880 and I have prospected at intervals ever since, but I am one of the prospectors that has never made a strike. It is a fact that there is a clash between the mining engineers and the prospectors. No matter what the mining engineer may think, he is a twin brother to the prospector. He has had the advantage of an education in our best colleges, which has enabled him to learn that which takes a prospector a lifetime to learn. There is no doubt but what there are mining engineers as well as prospectors that ought to be in some other business. The qualifications for an engineer should be honesty and a fearless courage to recommend a property just as he finds it. This kind of a man, if he does make a mistake and lose his position, will not stay down long, for his force of character will enable him to overcome all obstacles. This kind of a man and the geologist that understands his business are the best friends the prospector has or ever will have. I am willing to take off my hat to them for the great work they are doing. I believe the average prospector makes a mistake in submitting to hard bargains for his claims, but the claim-owners incorporate and issue stock to the amount of what the claims are supposed to be worth and concentrate their efforts on the best ground. There is nothing like self-help. The districts where veins cropped conspicuously or where erosion has been so excessive as to make tracing by panning easy have been prospected fairly well, but what of the great belt of acid lavas of the Tertiary epoch extending for thousands of miles north and south a greater part of the way through two continents, the deposits in which for the most part have suffered very little erosion? Here is where an education in geology is valuable to the prospector. The first thing for him to ascertain is whether the formations are such that mineral is likely to be associated with them. If he has any doubt on that score, let him send specimens to the nearest mining school or State university and they will gladly put him wise. No prospector should start prospecting in a district till he has ascertained what the formations are, observing the hydro-thermal alteration in areas that are well broken by faults or dikes and around the lower margin where the strata have been closed. Such a district as this may show no ore on the surface. Watch the changes in the country-rock along such fractures, the addition of silica approaching the fracture; look for pyrite or stains of manganese oxide. There are many districts that contain no signs, but such conditions are caused by the lack of erosion. Most of the time for the last five years I have been prospecting in the very northern edge of Nevada and south-eastern Oregon. Of the prospectors I met there, not a single one took a mining periodical. Most of the old-timers I have met know very little about the ways of modern prospecting. Nobody is to blame for this condition but themselves. I am in favor of every State compelling its prospectors to register a reasonable fee for the same. A State that has a Geological Survey should have charge of this work and should have a list of all prospects and mines that are for sale. I am in favor of continuing the annual assessment work, but the prospector should be permitted to do the annual labor on all the claims he has or one claim if he desires to do so. As it is now, all mining men know that a great deal of this labor is wasted. Many prospectors are quitting the game because they have a lack of technical education. The present conditions are not good for old-time methods.

I have no grievance to register. I might mention a mischievous clause in the Ashurst mining law where it says "at the discretion of the Secretary of the Interior". This gives the prospector some red tape to uncoil.

C. H. McCumber.

Beatty, Klamath county, Oregon, June 16.

Zinc-Silver Ore Treatment

The Editor:

Sir—In your interview with Mr. D. W. Brunton and with reference to the treatment of "the middlings, which consisted of pyrite and blende" carrying "a large amount of silver", the following treatment was designed, quoting Mr. Brunton: "At the Stewart mill I found that when the ore carried a high percentage of zinc and was roasted at a low temperature, chloride of zinc was formed, which acted as an excellent solvent of silver." If we continue reading we find that at Silver Peak there was salt in abundance; but at the Stewart mill the pyrite and blende were roasted, and produced chloride of zinc, which dissolved the silver. The question is, are we to take this paragraph as written or is it wrong? How the chlorine got into the Stewart ore is not mentioned, or why, if roasted with salt, the silver should remain as silver and not as chloride. The paragraph may mean that at the Stewart mill the mixture of pyrite and blende

was roasted with salt at a low temperature, producing both chloride of zinc and silver; and the chloride of zinc dissolved the chloride of silver. Kindly elucidate this puzzle as some of us doubt that chloride of zinc is a solvent for chloride of silver or even of silver as stated.

Nayarit, Mexico, June 2. ALGERNON DEL MAR.

The Editor:

Sir—In reply to Mr. Del Mar's inquiry, I wish to state that the method of silver extraction (U. S. patent No. 228032), briefly sketched in the interview, was simply a variation of the Augustin process, in which the solvent power of the salt solution was increased whenever the ore, before chloridizing, contained blende, by the presence of chloride of zinc and incidentally by the chlorides of calcium and magnesia.

In the Augustin process, the silver ore, after being subjected to a chloridizing roast, was lixiviated in an ordinary leaching-vat; in the other method, usually dubbed 'chloride leaching', the hot ore from the chloridizing-furnaces was run directly into agitators and stirred until the solution was complete, a procedure which greatly expedited the rate of solution. That this method was a success is evidenced by the fact that all of the mills mentioned were operated at a profit until the available supply of ore was exhausted, during which time they produced many hundreds of thousands of ounces of bar silver over 900 fine.

D. W. BRUNTON.

Denver, June 17.

Metallurgical Methods at Rio Tinto

The Editor:

Sir—I have read with great interest Mr. De Kalb's article on cementation at Rio Tinto, and also Mr. Van Arsdale's comment on the same. Claiming some little experience in heap-leaching, I thought I might be allowed to contribute to the discussion.

Referring to Mr. Van Arsdale's simplification of the equation (1), which he writes as

$$4FeS_2 + 28O + 4H_2O = 4FeSO_4 + 4H_2SO_4,$$

why not simplify it further and write

$$2FeS_2 + 14O + 2H_2O = 2FeSO_4 + 2H_2SO_4,$$

as $2FeSO_4 + 2H_2SO_4$ is all that is required to carry on the good work. However, I think that the equation as given by Mr. De Kalb is the correct one:

$$33FeS_2 + 28O + 4H_2O = 29FeS_2 + 4FeSO_4 + 4H_2SO_4,$$

the excess of $29FeS_2$ representing the large mass of unattacked pyrite, which, as is well known, is later shipped for its sulphur content.

Mr. De Kalb refers to the first cement copper as being produced at Rio Tinto in 1752, from mine-water only. L. de Launay says* that the first cement copper was made at Rio Tinto in 1752, from heaps that had undergone a natural decomposition by atmospheric influences and that had been leached out by water, the copper being precipitated on iron. The process met with strong opposition from the then general superintendent of the Hacienda Real, Don Pedro de Lerina, who stated that the cement copper obtained was nothing more or less than iron coated with copper, and that this falsification would do a great deal of harm to the Spanish copper trade. After a long series of experiments by some celebrated chemists at Madrid, it was shown that the Don had made a mistake, but it took a long time before the lixiviation process was looked upon with favor. See also M. Eissler's 'Hydro-Metallurgy'. It might be worthy of note here, that cement copper was produced from mine-liquors at Schmollnitz in Hungary in the 15th century.

With regard to the washing of the heap, indiscriminate running on of solutions would never do. As Mr. De Kalb suggests, great care is necessary. The precept to be kept constantly in mind, is to obtain "the best product in the shortest time at the least expense". In other words, to get the maximum amount of copper with the minimum volume of solution. There is, however, a compensating balance at work all the time, and just when a certain portion of the heap may be getting 'cold' or 'drowned', other physical features present themselves, which indicate clearly to the superintendent in charge the urgent necessity of moving the wash-liquor to some other part of the heap.

Referring to Mr. De Kalb's statement on the solubility of zinc, that it does not precipitate in the vats, that is quite correct, but neither does it re-deposit on the ore, at least to any great extent, as it is found in large and almost equal quantities in the heading and tailing of the *canaleo* or cementation plant. Such was my experience for several years at Cuchichon.

I was glad to see Mr. De Kalb refer to the heap-leaching of silicious and schistose ores, as that practice is particularly applicable to this country, and I regret he did not give us even more details, and further enlightenment on this feature of the method. At Cuchichon they treat a schist containing about 1% copper. Heaps are about 20 ft. high (6 metres). They are washed with water from the mine, augmented by some waste-liquor from the plant. The liquor entering the cementation plant carries about 5.50 lb. copper per 1000 gallons, and leaves with from nil to 0.16 lb. copper per 1000 gal., showing a recovery in the plant of more than 97%.

Mr. De Kalb gives the time necessary for leaching these silicious heaps at Rio Tinto as ten years, which seems a very extended period. A silicious heap at Bisbee, 20 ft. high and containing about 13% copper when built, showed an extraction of close on 73% in three years—a slight improvement on Spanish practice.

I notice that in Spain they still cling to the idea of many kilometres of shallow canals for precipitation of copper from solution, while here deep vats with false bottoms and stirring mechanisms are being considered as the best vehicle for such work. In fact, the vats have already shown themselves to be most economical and efficient.†

*'Annales des Mines; Memoire sur l'Industrie du Cuivre dans la Region d'Huelva', Paris, 1889.

†See 'M. & S. P.', Feb. 12, 1921.

While the Huelva-Seville district has long been regarded as the cradle of heap-leaching and natural cementation, it may be, as the child is sometimes father to the man, that in the not-distant futuree, our brother metallurgists on the other side, may study with some interest the heap-leaching and cementation plant results obtained in our South-West.

Jerome, Arizona, June 11. JOSEPH IRVING.

Prospecting

The Editor:

Sir—With all due respect for the sincerity of the writers of recent articles intended to improve the lot of the prospector, I beg leave to put a few small flies into their ointment. Can any of these writers explain why a man who holds claims from year to year without much actual benefit to them should be protected by law in so doing? Such a claim-holder dare not defraud a neighbor or group of individuals without fear of trouble; yet he is well protected in defrauding 110,000,000 fellow citizens, who seem to think that he needs protection in defrauding them still more. What else can you call it if the requirement of annual assessment work be stopped altogether, as some think necessary to solve the puzzle?

I admit that a large proportion of mining claims, both locations and patents, are being held for speculation. Every business has some speculation in it, and mining has always and everywhere been more speculative than perhaps any other business that has need of scientific knowledge. I also know that much territory for grazing of stock is meant to pay its real profits from mining leases and sales in the event of the finding of a paying vein on the property. This has been done often in Calaveras county, and also in other districts to a smaller extent. The patentees take advantage of the fact that patent titles cannot be reversed, because of error or fraud, after seven years. The grazing furnishes an ordinary profit on the use of the capital required to obtain patent and to fence.

The only possible way that a prospective buyer can have protection against imposition in dealing with owners of small undeveloped prospects and wild-cat properties is by being slow, cold, thorough, shrewd, and independent. Anyone who cannot so qualify as such is foredoomed to failure. Even if qualified, he may make an expensive mistake, because he is still handicapped in other ways. But that is not my subject. I have studied the Mother Lode country since coming here and have experiences to remember.

To get back to speculation in mining claims: the real unfairness can be remedied by the 110,000,000 people when they assert their sovereign rights of ownership to all mining locations, by requiring every 'proof of labor' to state where assessment work was done and how it benefited the location to the extent of $100. As the 'proof of labor' now operates, it need include no definite statement in a case of fraud as to where or how there was benefit, or an outlay approaching $100; it puts the burden of proof upon the true owner to show that he did not fulfil his full duty in trust. There is now little chance of true proof of fraud.

The honest locators and holders often leave their locations, vowing that they will do no more work on such worthless property; or they do their work regularly and tell about it, and may disdain to file 'proof of labor' as evidence that they are honest men. The dishonest ones hold on and on, filing 'proofs of labor' because no one can watch any of them for 365 days in any year; and no one is able to swear that no work was done. The courts have been favoring any claim-holder who can prove that he did any small part of his $100 worth of annual work or permanent benefit per claim. The principle is right, but the practical application is usually wrong. It is wrong for a 'proof of labor' to be admitted as direct evidence when not sworn to; California requires that it shall be sworn to before being admitted as evidence in her courts.

The remedies of the abuses stated in this letter are manifestly the business of the legislative branches of each State wherein is the greatest hope of correction. It is far more customary for the dishonest location holders to file 'proofs of labor' than for the honest ones. Many an honest locator or location holder depends on the added improvements to prove his annual assessment work; he is proud of what he has done and demands that it suffice. A trick practised at times is to freshen the surfaces of weathered dumps and excavations, to indicate that assessment work has been done!

GEO. E. MCCLELLAND.

Sonora, California, June 6.

The Editor:

Sir—It is with intense interest that I have read the contributions regarding prospecting in your recent issues. I believe Mr. Davis is right in his statement that "we have spent too much of our time . . . on small streaks". It indicates one of the main reasons why so few mines of consequence have been discovered in recent years.

Most prospectors put in too much time on the smaller veins because there is a better chance to find high-grade ore, and there is always a better opportunity to sell such prospects, or at least to induce others to furnish funds for further development, even though the ore does not occur in paying quantity. On the other hand, the prospect that has "the earmarks of a big mine" seldom has ore of shipping value near the surface, and it is almost impossible to interest capital in its development, unless it is near, very near, a booming camp.

The development of this class of prospects will certainly help the situation, as it will encourage the prospector to look for them instead of chasing high-grade streaks. No doubt the promoter, on whom the prospector frequently depends to get his wares to market, is largely to blame. He is seldom a mining engineer, or familiar with the geology of ore deposits, and it is much simpler to raise funds on high assays than on even the

most favorable geological data. He naturally prefers the proposition that promises the largest returns for himself, and producing mines are not a necessary adjunct to his operations. Higher commissions are paid for financing prospects than for any other purpose. A better system of financing prospects is certainly necessary if individual effort is to survive.

If these changes cannot be brought about, prospecting as a gainful pursuit for the individual is likely to come to an end, except possibly for those few fortunate individuals who are possessed of the "inevitable requirements" enumerated by Mr. Davis, and sufficient financial backing.

W. F. KORF.

Round Mountain, Nevada, June 10.

Coloring of Glass

The Editor:

Sir—Assuming that the letter of Mr. Francis Drake on this subject in your issue of June 11 invites an explanation of the phenomena of colorless glass turning purple in prolonged sunshine, I venture to mention the deductions I formed many years ago as to the cause of the coloring.

Manganous compounds are pale-pink in color; manganic compounds are violet in color; permanganic compounds are purple-red in color. Compounds of manganese produce an amethyst color in the borax-bead (manganic borate); in the reducing flame this color disappears (manganous borate). These chemical reactions are well known and simple, but are mentioned as being essential to understanding of the cause of 'amethyst' whiskey-bottles.

In the making of colorless glass, manganese dioxide is added to oxidize the green ferrous silicate, caused by traces of iron in the sand, to the almost imperceptible pale-yellow ferric compound. The faint-pink tint of manganous compounds in the glass also tends to mask the pale-yellow color produced. This explains the so-called colorless glass, but the actinic action of the sun's rays, or of an intense arc-light, changes the pale-pink of the manganous compounds to the strong violet or purple of the manganic or permanganic compounds. The reactions involved may be more complex than here indicated, but the explanation will suffice for the present purpose.

The optical glass used in projection lenses in the 'movies', under intense light, is rapidly turned amethyst or purple in proportion to the quantity of manganese dioxide used in its manufacture; similarly, the eye-glasses made to relieve the eyes from sun-glare are colored faint or strong amethyst at will by varying the quantity of manganese dioxide used, but in this latter case instead of waiting for the slower actinic action of the sun's rays, the glass is placed under the intense action of strong electric light, which does the work in a comparatively short time. Arc-light globes in our city streets and elsewhere are turned amethystine in the same manner. Probably, if the Boston residents knew how rapidly their old violet-colored windows could be reproduced, they would not feel so proud of them, but it would be a pity to apprise them of the fact.

Finally, your own jocular foot-note may be further played upon by giving the definition of amethyst, that is, resisting wine, the Greeks believing the stone and plant of that name to be preventives of intoxication.

Los Angeles, June 14. R. D. PERKINS.

The Editor:

Sir—The letter from Mr. Francis Drake in your issue of June 11 mentions a fact that has long been observed in certain kinds of glass. I remember, as a child, visiting an old farm-house and out of a dozen drinking-glasses, five or six of them were decidedly violet in color. I was never content unless I had one of these "purple glasses" at meal times, although they were considered inferior by the rest of the household. Later, I observed this same phenomenon in milk-bottles, fruit-jars, and, once or twice, in cut-glass. The windows at the farm-house mentioned above also had a decidedly purple tinge and this color was always a source of mystery to the people thereabouts.

The following excerpt from Thorpe's 'Outlines of Industrial Chemistry', 3rd edition, pages 198-199, gives the cause of this phenomenon: "It is customary to employ other ingredients in every glass mixture, to assist in the decolorization or fusion. The commonest decolorizing agent added is pyrolusite (binoxide of manganese, MnO_2). Iron, when in the *ferrous* condition, imparts a green color to glass; but when in the *ferric* state, it is much less troublesome, since it gives only a pale yellow color. By the oxidizing action of the pyrolusite, ferrous iron is converted to the ferric condition; moreover, the silicate of manganese has a violet or pink color, and so helps to neutralize the green. Only a very small percentage of pyrolusite should be thus used. The remedy is not a permanent one, and *if the glass is exposed to strong sunlight for a long time, it develops a violet shade, as may often be observed in the window panes of old houses.*"

The fact that this phenomenon occurs most frequently in 'potash' glass (glass having a potassium carbonate base) has led some investigators to believe that this coloration is due to the potassium present, which undergoes, in strong sunlight, a change of state that is not, at the present, fully understood. Other investigators hold that the change is partly the result of pyrolusite and partly of potassium. It has, however, been clearly proved that pyrolusite must be present wherever this color change occurs.

FRANK J. G. DUCK,
Assistant Principal, School of Metallurgy.

Scranton, Pennsylvania, June 14.

ACCORDING to figures compiled by the U. S. Geological Survey, the quantity of salt produced in the United States in 1920 was 6,965,188 short tons. The value of the product was $30,539,168, or nearly $3,500,000 more than any other year.

Training for Foreign Exploration

Commencement Address, Missouri School of Mines, April 29, 1921

By H. Foster Bain

Mining engineering occupies a borderland. In common with other branches of engineering, it is an "art and science by which the mechanical properties of matter are made useful to man in structures and machines", but with a difference. The civil engineer digs a hole to put something in it, a foundation perhaps. The mining engineer digs a hole to get something out of it, the ore. If he puts anything into the hole, timbers to support the excavation perhaps, he does it grudgingly and always with a view to the utmost economy of material. He cannot, as can his fellow professional, build with an eye to the long future. He must always face the fact that his main object is to get things out of holes, and that when he has got out of the hole all that Nature had put in it, neither the hole nor the plant used in the work has any further value. There is but a modicum of salvage upon which he may count. In many particulars his work shows analogies to that of the contractor, and the same logic that leads a contractor to low first-cost installations is good, within reason, for the mining engineer. He does his work and moves on; and there is probably no profession calling for equal skill and learning, in which the members wander more. Always they are seeking or extracting or utilizing material forming part of the crust of the earth, and usually are doing it under conditions or with equipment that is at least suggestive of being temporary. The mining engineer must improvise, and he must be versatile. Of him it may be written as Kipling has of the marine:

For there isn't a job on the top o' the earth the beggar
don't know nor do,
You can leave 'im at night on a bald man's 'ead to
paddle 'is own canoe;
'Es a sort of a blooming cosmopolouse—soldier and sailor
too.

To the lore of the geologist he adds the skill of the engineer and the science of the metallurgist. Always and everywhere an eclectic, he adapts means to the end. Clearly where there are such varied duties and opportunities, room for specialization exists; and this is, indeed, the fact.

Mining engineers, employing that term in the broad general sense in which it has common usage, are called upon for three sorts of work: (*a*) geological, (*b*) mining proper, and (*c*) metallurgical. No one man may be expected to be competent in all three, and each branch is really a profession within a profession, but a man who stays long and achieves success in mining engineering must know something of all three, and young men who leave the schools, regardless of the point of the triangle at which they begin, seem in practice liable to end at either of the other. Each of the three has applications outside mining, or verges over into other fields. Thus the border-line between metallurgy and chemical industry is shadowy, the ties between mining engineering proper and civil engineering are many and close, and geology is a broad science which touches many fields aside from those related to ores and minerals. It is, however, the light that geology throws on the genesis and especially the occurrence of ores and minerals that interests the miner, and it is in finding minerals and guiding development that it is of most direct benefit to him. This work is fundamental to mining. And it is the work of the exploration engineer. It may be of interest to inquire as to the probable future demand for his services and the training necessary to qualify him for service.

Mines are wasting assets; the very life of the mining industry is dependent upon the continual finding of new mines, new orebodies, and new reserves. When this stops, mining will stop, though the death may be a lingering one. Whatever may be true as to a particular type of mining or mining in a particular locality, it must further be clear that so long as man persists on this earth he will have use and need for some portions of its crust and that, therefore, mining in some form will continue. Each individual mine, be it ever so long-lived, is eventually worked out and becomes worthless, and other mines must be found to take its place. The emphasis changes and minerals or metals eagerly sought by one people or one generation are less important to those who come later, sometimes because their wants are supplied from a different source. In the early settlement of the Mississippi Valley local salt-supplies were so important that salt lands were generally set aside as being of particular value. Now these local supplies are of so little importance that they are generally not worked. Nonetheless the salt industry is manyfold larger and more important than was contemplated by our grandfathers. The human need for salt is as great as ever and with increasing population more salt, and hence more salt mines, have been needed.

As there comes to be more people in the world there will be more need for mineral products, and, disregarding the substitution of one for another, the minimum rate of increase in output for the minerals as a whole may be safely taken as that of increase of population.

There is an additional factor that lends assurance to the future of mining. As civilization spreads and industrialization becomes increasingly intensive, the per

capita consumption of minerals increases. Man comes more and more to depend upon energy taken from the earth to supplement his own labor. The brilliant civilization of the Greeks was based upon slave labor. It is worth remembering that in the golden age which the classicists so love to recall, the mines of Laurium, worked by slaves, were so productive that each citizen of Athens received a dividend in place of an annual tax-notice. Naturally, they had time to sit around in the sunshine and talk philosophy. The people of our time will not tolerate slavery. We have found a better way in that we harness to our use the energy of falling water and of fuels, and so are each served by invisible non-consuming genii of the earth. The peoples who make the most use of earth materials and forces are the peoples who work the shortest number of hours, produce the most goods, and have the most to divide among themselves. There are great differences between the peoples of various countries and centuries in this particular. Probably the civilized man, on the average, eats little if any more food than his ancestors did, but he does burn more coal and use more metals. Even among the various peoples of the present there are differences. The Chinese use about 1/20 ton of coal per capita per annum. Americans use approximately 6 tons, and other peoples use various amounts between. Generally speaking, the world is learning to use more and more coal and so to substitute the mechanical energy of heat for human labor. The pre-war per capita consumption of copper in the United States was 6 to 7 pounds and for France about ¼ pound. In Russia it is very much less, but nothing can be more certain than that through a term of years peoples of other countries are going to approximate more closely to American standards of consumption. The United States is by no means the only country where modern plumbing is appreciated, and as the cult of the bathtub spreads around the world the consumption of the metals will grow. This demand can only be supplied by re-use of old metal or by making additions to the world's stock. Mineral wealth, fortunately, is not necessarily consumed in use. There is wastage, but there is also salvage, and large amounts of old metal are continually returning to use, so much so that important metallurgical processes such as making open-hearth steel and cement copper are based upon suplies of scrap metal.

The existing stocks of the various metals represent accumulations of all the centuries that have gone before, though very much the larger part has been won within the last hundred years. There have been times in the past when but little was added to the stock and there have been peoples who merely captured in war and used the metals mined by others. This was true of the Tartar dynasties in China. The peoples who ceased to mine ceased to progress in civilization and the great civilizations of the past were those in which the people laid under tribute more and more of the earth.

As yet no people are known who have accumulated a sufficient stock of metals to supply themselves by remelting and at the same time to make progress in civilization. Having regard to the many activities that led to wastage, it seems improbable that any active people will reach the stage where they will not require periodic additions to their stocks of metals. In the opinion of economists, also, no active people have yet reached a point of saturation as regards even steel, the most common of our metallic alloys. It seems, therefore, safe to assume that demands for minerals will continue to increase. Two methods of meeting this increasing demand are known. By improvements in technology and financing it will be possible to lower the limit of metal content which separates ore from waste and so increase the reserves in known deposits or make into ore deposits what are now mere mineral segregations. This is a fruitful field and calls for application of the highest type of skill and genius in our profession. It is one in which remarkable results have been achieved. Working 1% copper ores means handling 2000 pounds of material to recover less than 20 pounds of copper, for even the best practice involves losses. It is only possible to do this by application of excellent technology and remarkable powers of organization and financing. In producing helium from natural gas a raw material containing less than 1% is used and the technology involves incursions into low temperatures and high pressures not previously applied on any large scale outside physical laboratories.

A second way to meet the future demand for mineral products is to discover new deposits either of types made profitable by the improvements of process and business organization just mentioned, of types long known, or of new types. Fortunately there are opportunities of finding all three, and in all this work exploration enters. The search for 'porphyry coppers' has been a wide one. Beginning in the United States, it has long since spread into foreign fields. It has led men into many of the odd corners of the earth and there are regions yet to be explored. In conducting this work, knowledge of the widest character is desirable. When C. G. Gunther began his search in Mediterranean countries, which has resulted in the development of an American mine of promise on the island of Cyprus, the first step was a reading of the classics. The Romans and earlier rulers of the region had sources of copper which, while small as judged by present American standards, might, it was thought, well point the way to a source for modern production. It will be recalled that the Utah, Chino, Ray, Nevada Consolidated, and other of our modern enterprises were built on older small-scale undertakings. Seeley W. Mudd, the eminent mining engineer who studied in a Missouri school and began his professional career in a Missouri copper mine, had the vision of applying in the Mediterranean region the knowledge which had grown out of American experience. He and his associates found in Mr. Gunther an excellent and enthusiastic agent. The work began, as I have intimated, with a careful review of the classics and was followed by field studies first in North Africa and later in Asia Minor, where old mines offering promise of profit under modern methods were found. I cite this instance to enforce the

observation that no knowledge comes amiss to an exploring engineer. I hope it will not be construed into an argument for making Greek and Latin required courses in mining schools, but it does show that wide learning is of real value to a mining-man who purposes to do more than conduct a local and minor operation. As for Greek and Latin, mining-men as well as others who can without undue sacrifice of time become acquainted with them, will gain by doing so. It is well, though, to preserve a sense of proportion and mere knowledge of foreign languages, ancient or modern, hardly qualifies one to assume responsibility as an operator or advisor in mining. Indeed, a surprising amount of work can be done through interpreters, since to a good geologist the rocks speak direct and a competent miner or metallurgist can piece together the story of old works and furnaces from scattered remains, drawing inductions as surely as does the vertebrate paleontologist from a few bones. Get all the knowledge of modern languages that circumstances permit. Some have a facility in this which carries them far, but remember that it is but a means to an end. In the course of a recent professional trip, lasting some twenty months, business took me into countries and regions where eleven distinct languages or dialects were used, so distinct that for each interpreters were necessary. If I had stopped to learn each language before transacting business I would never have found time to do the work for which I was sent. Such experiences are not unusual in these modern days of wide travel. It is helpful but not necessary to know modern languages. Even when no interpreter is available, a few simple words will carry you surprisingly far. It is not only that they are usful in themselves, but they help to establish friendly relations. People generally take it as an effort to good understanding that you have tried to become qualified to talk to them in their own tongue, and words in any language carry an accumulation of associations which is left behind in translating. You must, however, depend largely on yourself. Use your eyes and your feet. Get out into the field and observe. Leave, if you must, puzzling questions as to labor-supply, laws, and regulations until you can get a competent interpreter, but for the facts as to character and extent of the deposit you wish to see, depend on your own powers and energy.

I am speaking now of language study as a means. Language and the whole group of so-called cultural studies have another use, one not to be overlooked. If you purpose to be an exploration engineer you will spend much time away from home, often under most uncongenial surroundings. I once asked a young man returning from an outpost in West Africa what he considered most important for one to have before going into such work. I was a bit surprised when he answered, "a college education". Experience had taught him that a well-stored mind is the best companion, not only in solitude, but of a man surrounded by primitive and brutalizing conditions to which he does not wish to succumb. It has been my experience to note young men of good antecedents who have dissipated and become mere brutes when left alone among savage or nearly savage people for lack of mental reserve. Mental balance and mental resources are of peculiar value as stabilizers under such conditions.

Search for 'porphyry coppers' and similar deposits will almost certainly carry you into regions of ancient mining. It is well to be on your guard neither to underestimate nor over-estimate the older civilizations. The ancient miners did many things well. They are apt to have exhausted the bonanzas down to water-level, and high-grade ore in old workings is rare. Their costs were low, since the mines were operated mainly by slave labor. It does not follow that because others worked a mine for centuries or even because it yielded a considerable aggregate of metal that it can be profitably exploited under modern conditions. With primitive tools the ancients accomplished wonders. There is, however, one assumption that it is usually safe to make—they did not work far below permanent underground water-level, since no amount of human labor quite accomplishes the work of modern pumps.

Just as we must remember that price relations of labor and metal were in ancient times very different from those of today, so we should bear in mind that in the past people were satisfied with amounts of metal that would be considered insignificant now. E. C. Eckel has pointed out that at the time of the discovery of America the total amount of gold accumulated in Europe in all forms was worth less than $100,000,000, and that up to the American Revolution the iron made annually in this country was but 15,000 to 25,000 tons. Even at that it was equal to the output of England. Many deposits which would satisfy such demands are of no importance whatever under modern conditions of business and technology. Whole groups, therefore, of ancient workings may be passed in review quickly once you are satisfied as to their type and average extent.

Finding deposits suitable for large mining enterprises is, however, not the whole of the work of an exploring engineer. He may be employed to look up sources of some mineral that does not occur in large bodies, such as tungsten or vanadium. In such cases, little bodies must be regarded as jealously as are large ones of cheaper metals. A due sense of proportion is of high value to him and an intimate knowledge of the mode of occurrence of the mineral he is seeking to find is a first essential. Placer gold has a natural habitat and there are characteristic differences in types of deposits which may be correlated with the character of the country-rocks, the extent of their metamorphism, the presence or absence of intrusives, the character of the latter, the physiographic history of the region, and similar geological features. Much is known now of metallogenic provinces and something of paleography. All this and more is useful to one engaged in finding ore.

In estimating the value of professional knowledge necessary for success as an exploring mining engineer, I would, therefore, place a good working knowledge of

geology first. This should extend not only to the technic but to the sources of information and to current knowledge of the geology of the region to be explored. A metallurgist or a mining engineer engaged in the operation of properties does not need so comprehensive an understanding of geology. It is sufficient if he knows the general scope of the science and the particular ways it may be applied to problems he must face. It is by no means necessary that he should be versed in its technique, since there will always be within reach men skilled in the art who may be called to his assistance. What he should know is when a geologist can be helpful and how to use him in his work. It would be better for such men to concentrate their time and energy upon acquiring a complete mastery of their own work rather than an amateur and probably misleading knowledge of geology.

In the case of the exploring engineer the case is different. His prime function is to find ores and to do this he must know orebodies and the laws which govern their occurrence. These laws are imperfectly understood, much regarding them remains to be learned, and to resolve these doubts calls for the most complete knowledge obtainable concerning the principles of geology, the history of the earth, and the technic of making geological studies. It is therefore important that the exploring engineer should be first of all a well-trained geologist, one capable of observing, recording, weighing, and judging the numerous facts of which account must be taken in making his determinations.

Much observation has convinced me, though as to this there are differences of opinion, that it is better if he learn his geology first as a scientific study. There is a high value in the detached point of view of the man who loves science for its own sake and counts truth as most important. Men so trained have usually more vision. They have a wider knowledge of the literature of the subject and of the work of others. They are less eager to accumulate only the facts of immediate importance and so have more facts and more theory upon which to fall back when in difficulty. They do their better work because they look over the whole problem first. Not infrequently they make large savings by eliminating unprofitable work through preliminary study of literature. For all these reasons I would recommend the man who purposes to devote his time to exploration to study geology first and to study it as though he expected to be a professional geologist.

This, however, is not alone enough. It requires but little knowledge of the field to recognize that many serious mistakes have been made through relying on the advice of geologists. For this particular work of finding ore is needed more than the usual equipment of a good geologist. The latter is rarely versed in economics, and this is almost equally essential. Too many geologists have no adequate understanding of the relative importance of things from the miner's point of view. Not being trained in assuming financial responsibility for mistakes, they are cheerfully optimistic when to be unduly so invites failure. Their first tendency is to general advice and all too promptly they will sketch out plans for development that call for millions when perhaps thousands alone are available. The geologist therefore needs further training before he is properly prepared to advise regarding mining development.

When the prospective exploring engineer has completed his scientific studies he needs help and criticism from his fellows, the mining engineer and the metallurgist. It is not necessary that he should become equally learned in their branches of the profession, but it is essential that he have a clear conception of the scope, character, and limitations of their work. It is his business to find the ore which the mining engineer shall mine and the metallurgist treat. Clearly no one will be profited by his finding and mapping metalliferous segregations which cannot be mined or are not amenable to treatment. It may be highly interesting and of great scientific import to map such bodies of mineral, but that is the function, among others, of the geologists of official surveys. The exploration engineer must work to find something out of which a profit may be made or he has not found ore. Clearly he must know, at least in general terms, the limits of cost which separate ore from rock, and he must have some well-defined idea of the technical difficulties to be overcome in mining each particular deposit and of the methods likely to be applied. It is not necessary that he should be able to make the application. That calls for skill of another character, but he must know, and know surely, that some one of several methods, perhaps, may be applied and must be able to approximate the cost. It is useless to find and drill placer-ground where the boulders are too large and numerous, or the bottom too hard or pinnacled, to permit dredging while the supply of water, of storage space, or the grade prevents hydraulicking or sluicing. There are dry placers, it is true, but if the exploration engineer finds conditions so unfavorable he would do well to defer drilling until after taking expert advice as to methods and costs of dry washing. It is also useless to spend money on a careful examination of a placer property unless there is reason to anticipate that the gravel will yield as much or more than the cost of working elsewhere under similar conditions. To determine this, one must know what constitutes similar conditions and what usual and unusual costs are. It is no part of the ordinary training of the geologist to accumulate such data, and if he is to succeed in exploration he must draw on the experience of the engineer, for it is either by serving an apprenticeship under him or having always a competent engineer as an associate. The latter is not always feasible and it is greatly to the benefit of his future if the geologist will serve for a time as helper to a good engineer in operating or examination work. It will help him to get into the habit of quantitative thinking and he will learn much of the law of averages. For one thing, engineering methods of sampling are on a much sounder basis than are those of the geologist. It is one of the minor tragedies of scientific work that so much high thinking is done over non-representative samples. Geologists generally have the same naive confidence

as has the prospector and promoter in their ability to take a 'grab' sample which will be representative, and this is a common source of error and disappointment.

Having said so much in disparagement of the profession which I have long loved, let me add that in the study of placers there is no knowledge that entirely compensates for lack of clear conceptions of geologic history and skill in geologic interpretations. Placers are the products of rivers or beach action. Their accumulation is an incident in river, lake, or marine history and may be closely correlated with the physiographic history of a region. There are definite places at which they may be expected to occur and others at which it is useless to seek them. Frequently they relate back to ancient rivers and to physiographic stages in the past whose marks, obscured by later changes, may be picked up only by the skilled eye, and of which the evidence may be correlated only by an active well-trained brain. To indicate the need of supplementary training and experience is not to discredit what is sound and useful in that already given to geologists. While I have drawn my illustration from the field of placer mining, a similar argument may be made in the case of lode mining, where structure, secondary enrichment, and other phases of geology are equally important, but where also it is necessary to know in outline of mining methods, especially of the critical limits, both technical and financial, of their application. The situation is the same in exploration for gas and oil, except that petroleum technology, being newer, is not as yet well formulated and the financial limits are more elastic. The rewards of success in oil and gas production are so much larger in proportion to the immediate investment, and the returns are so much more prompt, that it is not possible to estimate probable costs as closely as in other forms of mining.

Consideration of costs leads one into the larger field of economics, a popular branch of learning just at present. Aside, however, from this new general interest in what was once called "the dismal science", and belief in its applicability to present-day problems, there are permanent reasons for the exploring engineer acquiring more than a slight acquaintance with economics.

Minerals are the raw materials on which are based numerous industries and the conditions which limit their use are the same in many particulars as are those which unduly aid industry in a given region. Security of title, stability of government, availability of labor, adequacy of financial support, these are all matters to be considered in exploration and they are also matters studied by economists. Here again the exploring engineer may to his advantage draw on a fellow professional for methods and data. His own training prepares him to judge as to the material. Matters concerning men and money are, however, equally important, since the test of his results is whether he has found something which may be produced with reasonable expectation of profit. The subject is too large for discussion here. I may merely mention a few items by way of illustration.

One of the assumptions too commonly made is that low wages necessarily means cheap production. This may or may not be true. It is largely a matter of efficiency. If it requires, as it sometimes does, six miners of one race to do the work of one of another, it must be clear that paying wages in the ratio of one to six does not lower costs. Not only that, but the final cost of production with such 'cheap' labor will be higher because of the larger number of working-faces necessary in the mine, greater amount of equipment, the extra supervision and housing, the higher accident-ratio and other matters, all of which enter into the final cost. On the contrary, one must not conclude that raising wages cheapens production. It only does so when increased efficiency results from the added desire on the part of the men to hold their jobs, or when it enables a particular employer to attract better men from others. Generally added efficiency in labor is purchased at an increased cost per unit, just as the added speed of a fast steamer calls for more coal per mile than when driving at a slower rate. It is also to be remembered that there are natural inequalities in efficiency and in the economical rate of speed of work as between men. These can only be changed slowly. Another factor to be constantly kept in mind by the engineer is that one of the costs of a new enterprise is that of attracting labor to it from existing industries. It may usually be safely assumed that the people of any district are already employed. If they do not work, they generally starve. What they are doing may seem relatively unimportant to the visitor, but it assumes another aspect to them. It is necesnary either to import men already accustomed to the industry, usually at material expense, or to tempt workers out of some other line into the new one and then train them to it. This requires both time and money. The importance of the time factor arises from its effect on the present value of proposed investment. To illustrate: deferring the initial returns for two years decreases by 14% the present value of a series of dividends running through 20 years at 8%, assuming accumulations at 3%. The actual result varies with the assumption of time and rate, but the essential fact is that mere delay is expensive. When this delay is coupled with upkeep charges it is even more serious. This whole matter of the possible and probable rate and continuity of production is one of first importance in determining the availability or value of any mine or prospect. Into it enters also the various questions of market. I have already indicated my reasons for believing that, whatever may be the depressing facts of the immediate present, we may safely assume a continued demand for metals. This demand will, however, vary from time to time both for the group as a whole, such variations being due to general causes outside the industry itself, but also as relates to each metal. It is necessary to study problems such as expansion of use, substitution, periodic demand, and similar matters far aside from ordinary class-room instruction. As regards a particular enterprise, it is necessary in fixing capitalization to make assumptions not only as to the probable average price of output during the life time of the in-

vestment but also the maximum and minimum to be assumed, the probable period of duration of each, and if, as is occasionally true, some guess can be made as to the impending swing of the pendulum, it will be of great assistance. A property is financed on the basis of average returns through an expected life determined by consideration of numerous factors. A company in which capital is so adjusted to income may nonetheless fail if not prepared to withstand a temporary period of low prices, while if high prices may be safely assumed in the near future it is possible to finance the enterprise from earnings to a considerable extent. There is one general rule, the old one that a "bird in the hand is worth two in the bush". This is sound not only because of the risk attached to the question of acquiring the two theoretically in the bush but because the one in hand, if a good hen, may lay eggs through the waiting period. The dollar of today is worth more, normally, than the dollar which is to be paid some years later, because it may earn for you interest meanwhile. This principle of the greater value of quick returns when astutely used is a great help in bargaining.

Just as any engineer starting for a far country carries in addition to instruments, food, and engineering supplies, a personal kit, so there are accomplishments that are as desirable if not necessary to the exploring engineer as his knowledge of mathematics and geology. He must know how to keep himself and his men in good health or his expedition will fail. He is the scout of industry and often the pioneer of civilization. When he goes into the wilds the health risk is often the greatest danger faced. Even when he goes to older settled countries, the conditions of life differ from those in his own home, and care is necessary. With care it is possible to live and work in almost any country. It is now known that where it is worth while to do so, even tropical jungle-lands may be made safe and sanitary. To do this involves heavy expenditure not warranted in exploration, so that the pioneers assume risks not necessarily met by the operating forces that come later. The exploring engineer would do well to look carefully to his own physical condition and watch closely the food, drink, and habits of his whole party. Learn and enforce proper rules as to camp sanitation. One careless man may wreck an expedition or cause long and expensive delays. It is generally true that the most suitable food is the food of the country, but the exceptions are numerous and the cost of a mistake serious. Until the facts in each instance are established it is a justifiable expense to use imported foods. Proper cooking will render safe foods otherwise dangerous, and moderation in eating strange dishes is a wise precaution. The American habit of drinking raw water is one to be indulged with discretion in regions of older civilizations, but safe water is easily obtained by boiling. It is worth while to pay attention to details such as these which seem small to those accustomed only to our own ways of living. A knowledge of the methods of first-aid and a few medicines is of great value. It is not necessary to go as far as Doc Milliken who, as you remember, would "take that bracket saw and the mild chloride and his hypodermic, and treat anything from yellow fever to a personal friend", but a little knowledge of simple medicines will ease your way greatly in strange countries. Learn to ride, to shoot, to swim, and to handle a small boat. I need hardly admonish a young American these days to learn to run a motor-car, but the accomplishment common in the older days of country and village life are becoming rare. It is not always possible to ride up to a prospect in a Pullman or even in a Ford. In the nature of things, the finding of new mines will take one into countries where only other than mining industries have been developed, and in practice that means going into regions of country and village life. At times it means rolling back the centuries and living for awhile in the medieval ages. In such places one must know about horses, and mules—their habits, preferences, food, simple ailments, and capacities for work. One may, too, be called upon to use a gun, though far more probably to afford the party fresh meat than as a means of protection. To handle a boat or to swim may be a necessity at any time, though it must be admitted that in any country where small boats are used native boatmen are likely to be numerous and skillful. Skill in any of the forms of what we now call sport may well prove of first importance in an emergency and will always prove at once a means of relaxation and of establishing relations with strangers regardless of race or language. The latter is a matter of no small importance in work when the goodwill of the whole party and of the people of the country traversed is so important.

Lastly, I would urge that to be successful one should have something of the spirit of adventure. Unless new scenes and new faces appeal to you, unless you find joy in the long days in saddle or afoot, unless the cheer of the camp-fire means more to you than the clank of the steam-radiator, unless to you coffee does not lose its fine flavor when served from a tin cup, unless you can sleep between blankets and not think of their scratching, do not undertake exploration. If you must have a napkin and morning paper at breakfast, if you cannot write save at a well-equipped desk, if you are not happy except with your family and intimate friends, if you need see the 'movies' before you can go to bed at night, you will be wise to find a routine job at home. But to those who have a venturing nature adventures come, and if you are one of the elect who feel the spell of the Yukon, or the lure of the little voices, then go

"Adventuring! Adventuring! and oh, the sights to see
And little fires along the trail that wink at you and me,
Till the last adventure calls us from the old, the vain
desires,
To a way that's still untrodden, though aglow with little
fires,
Where no wanderer grows weary and a man is free to
roam,
Or hang his hat upon a star and call the planet home."

THE LEAD SMELTER AT MORALES

Mining Activities Near San Luis Potosi, Mexico

By Robert B. Brinsmade

The city of San Luis Potosi, the capital of the State of the same name, lies on the main line of the National railway from Laredo to Mexico City, and is the western terminus of the branch railway that ascends from the port of Tampico. Situated at an altitude of over 6000 ft. above sea-level, it has the climate of perpetual spring, which is usual at this elevation on the Mexican plateau; and, being in Lat. 22°, it lies on the northern edge of a semi-humid climate that makes the landscape more verdant than that of the northern border. With its population of 40,000, central parks, and handsome public buildings, it offers an attractive site for industrial plants. The city derives its name from the mineralized mountain of San Pedro, 20 km. to the east, thought to resemble the famous Potosi hill of Bolivia.

The Mines of San Pedro. This town is situated on a railway of 3-ft. gauge built by the Cia. Metalurgica Mexicana to connect its works, near San Luis Potosi city, with the forests on the Gulf slope of the plateau at Rio Verde. Discovered by the Spaniards in the 16th century, the rich streaks in the outcrops were first worked, large quantities of lean ore being left underground, either as filling or as pillars. The lead ores were smelted in adobe blast-furnaces, and the silicious gold ores were reduced by amalgamation or leaching. A dump of charcoal discovered a few years ago was found to contain 2½ oz. of gold per ton—evidently the result of precipitation.

The early wealth of the district can be judged by the fact that the 20% royalty collected by the Spanish Crown between 1575 and 1863 netted no less than $72,000,000. At the latter date an incendiary fire destroyed the timbering, and caused a collapse of the stopes in the principal mines, which remained almost entirely inactive during the remainder of the Colonial period. The old stopes were finally re-opened by the Victoria adit, which was started during the War of Independence; but progress was slow until the general revival of Mexican mining in the 'seventies. In 1895 the construction of a modern lead smelter near San Luis Potosi enabled the mines to be again operated on the basis of large-scale production, after two centuries of almost complete inaction. Most of the old mines are now controlled by the Cia. Metalurgica Mexicana; and either by government titles or by lease, on royalty, of the properties of the Cia. La Victoria y Anexas, the company that completed the Victoria adit. The chief independent operator is the Cia. El Barreno y Anexas owning a mine that occupies the central part of the old workings and a cyaniding mill that has been run intermittently on silicious gold ores for over a decade.*

As may be seen from the sketch in Fig. 1 the geology of the *cerro* is simple. An immense laccolith of porphyry (hornblende porphyrite) has bored its way upward through the original sedimentary strata, and now appears as a wide dike-like outcrop on both sides of a central peak of blue limestone of Cretaceous age. There are thus three surfaces of lime-porphyry contact to explore for possible orebodies, namely, *K-e-f-g*, *p-q*, and *m-n*; but, curiously enough, nothing of importance has been found except on the first contact. The mineral zone seems to have been all discovered and delimited by the ancients, for modern exploration outside the old workings and in virgin territory has had little success. There are three classes of orebodies: (1) lenses, following north and south from *K-f* along the lime-porphyry contact; (2)

*'Ore Deposits of Mexico', by S. J. Lewis. 'M. & S. P.', Vol. 120, p. 444.

chimney-like veins in the limestone as *a-e*, *c-b*, and *d-f* which strike north and south and ascend from such contact nodes as *e*, *b*, and *f* to the surface; and (3) cross-fissures which occasionally connect the veins of Class (2). The best ore for smelting is that of Class (1) which, when in place, contains from 6 to 10% of lead. The old stope-fillings, as now shipped for smelting, contain 2 to 3% lead, under 50% of silica, 8 grammes of gold, and 200 to 250 gm. of silver per ton. The veins of Class (2) contain 60 to 80% of silica; when large, they are the richest in gold; when small, they consist mainly of iron oxides, poor in precious metal, like the fissures of Class (3). The dividing line for the content of FeO is about 50%; above that amount the orebodies are apt to be commercially worthless as far as gold and silver are concerned.

The main working adit for present operations at the Victoria group runs north and south in the porphyry from *e* (Fig. 1). It is provided with double tracks for

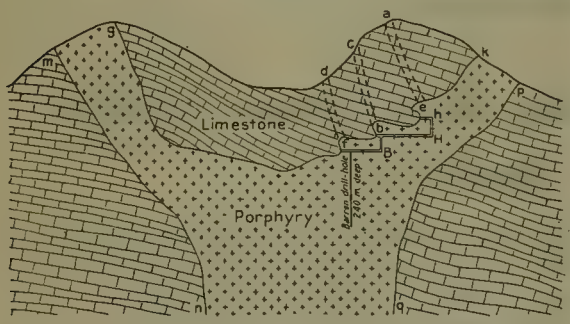


FIG. 1. GEOLOGIC SECTION OF SAN PEDRO

handling Koppel 1½-ton steel ore-cars which descend by gravity when loaded and outward bound. When empty they are hauled back by mules to the interior of the mine. Elsewhere the cars are also of Koppel make but have to be contracted in size in order to enter the shaft cages, and only hold 600 kg. The adit cars discharge into side-dump wooden cars—holding 4 to 5 tons—that are handled on the surface tramway, in trains of 10, by a Porter compressed-air locomotive. This tramway connects all the principal mines of San Pedro, and forms a feeder for the railway from Rio Verde to the smelter at Morales. Below the adit *e*, the lower levels are developed by inside vertical winzes. The cross-cut *e-h* connects the adit with the 'Hidalgo' winze *h-H*, from the bottom of which the cross-cut *H-b* cuts the lime-porphyry contact again at *b*. From *H-b* the 'Begonia' winze *b-B* has been sunk, from the lowest point of which another cross-cut *B-f* cuts the contact at *f*. Each of these winzes is 150 ft. deep and contains two single-deck cages running in balance from ¾-in. steel ropes, and handled by 15-hp. electric hoists, made by the Wellman-Seaver-Morgan Co. Steel-rope guides are used.

At the time of my visit, the Victoria mines were producing 12,000 tons of smelting ore monthly, and employed a force of 1300 men, nearly all of whom were working by the contract system. The zone of productive orebodies extended for 1000 metres north to south, and for 600 m. east to west. Much of the output consisted of old filling. The chunks of good ore were first picked out, the remainder being passed over 1-in. screens. The oversize was rejected; the undersize, with a high lime content and containing some gold and silver, was shipped. Power for the tramway, hoists, air-drills, and repair-shops comes from the distant Guanajuato electric supply system. The alternating current, of 3-phase and 60 cycles, arrives at San Luis Potosi city at a pressure of 70,000 volts, but for passage to San Pedro it is transformed to 15,000 volts. In the receiving-house at the mines the voltage is finally reduced to 440 for power, and 110 for lighting purposes. The water-supply depends on the impounding of the scanty local rainfall in dams and tanks; it is inadequate, and has to be supplemented by water hauled in tank-cars from wells in the San Luis Potosi valley at Kilometre 8 of the railway.

The present condition of the San Pedro camp is typical of many famous Mexican mining districts in that the cream of the rich ores near the surface was skimmed by the Spaniards. Nevertheless the ore deposits of the Cerro are so large and so numerous that modern methods of mining and metallurgy permit profitable operation, and at a rate of production many times greater than was attained in the olden days.

LEAD SMELTING PLANT OF CIA. METALURGICA MEXICANA. This plant is located at Morales, 5 km. from San Luis Potosi city, and is the terminus of the company's narrow-gauge railway to Rio Verde. About half of the ore comes from the near-by camp of San Pedro; the remainder is purchased from other districts. Its capacity exceeds 1000 tons daily, of crude ore that by means of roasting and blast-furnaces is reduced to base bullion for export to the lead-silver refinery of Monterrey, N. L., and medium-grade copper matte for sale to the Aguascalientes smelting works.

There are 11 blast-furnaces. A dust-flue connects with the furnace down-comers from the smoke-hoods on the feed-floor. The feed is shoveled by hand through long doors in the sheet-iron hoods, the charge being brought in barrows from the ore-bedding bin in the rear; the bottom of this is at the feed-floor level, the top being surmounted by the tracks that carry the entering cars of ore and fuel. Each furnace has a horizontal section at the tuyeres of 10 by 3½ ft. and operates with a 17-ft. ore-column under a blast-pressure of 24 oz. The hearth is enclosed by 16 cast-iron water-jackets, set six on each side and two at each end, each about 4 ft. high. A side-jacket has one 3-in. tuyere in its centre, and there is a total of 12 tuyeres per furnace. The nominal daily capacity of a lead-furnace is 100 tons; and this charge is handled by 3 feeders and 11 wheelers on the feed-floor, and 2 tappers and 1 boss on the slag-floor. The coke consumption is 12% for American or 15% for the native product; the usual slag contains 33% SiO_2, 28% CaO, and 28% FeO, with a ratio of CaO to FeO of 1 to 1. The slag is tapped intermittently into a steel fore-hearth, lined with adobe brick and set on wheels, whence it overflows into Nasmyth slag-cars that are hauled by light steam-locomotives to the

LEAD BLAST-FURNACES AT MORALES

dump. The fore-hearth is 8 ft. long, 3½ ft. high, inside its lining, and 3 ft. wide at the base, but only 2⅔ ft. wide at top—to permit quiet settling of the matte, which is tapped from a side spout into cast-iron molds. Much of the base bullion must be liquated on a small reverberatory hearth before it is clean enough for shipment, the resulting scum being re-smelted. The first matte is passed through a jaw-crusher and rolls, and roasted down to a sulphur content of 2 or 3%. After this it is re-smelted with silver ore, in two special blast-furnaces, one of 250 and the other of 150-ton daily capacity. Before the cessation of operations in 1914, the second matte was concentrated in the blast-furnace, re-roasted, and charged into a small reverberatory, where, mixed with half its weight of raw 60% matte and silver ore, it was reduced and cast into anode copper for shipment to the Balbach refinery at Newark, N. J. Since the renewal of smelting in 1918, the second matte has been shipped to the A. S. & R. plant in Aguascalientes. Originally the matte was roasted in Bruckner cylinders, but these have been superseded by hand-rabbled reverberatory hearths, which are built of local stone and provided, in the hot zone, with a lining of fire-brick. They are 15 in number, of which 5 have 70-ft., and 10 have 60-ft. hearths. The fuel previously used was cordwood, brought from the forests of Rio Verde on the company's railway. Last year the wood fuel was replaced by crude oil obtained from the Gulf Coast.

The sampling mill takes, according to richness, every fifth, tenth, or twentieth shovelful of ore as unloaded from the railway cars. The usual hand methods of coning and quartering are used to reduce the sample to a size suitable for assaying. For preparing fine ore, flue-dust, and roasted matte for the blast-furnaces, two 6-ft. briquette presses, made by Chisholm, Boyd & White, are used. The briquettes are hard enough for smelting after air-drying alone. The main boiler plant is of 1100 hp., of which 500 hp. is obtained from two Cook vertical water-tube boilers, and the remainder from four Stirling horizontal water-tube boilers. The blast is supplied by six Root and three Connellsville positive rotary blowers, all piped to a common main and operated by three single tandem-compound Corliss engines, made by Fraser & Chalmers.

BEFORE the Chamber of Deputies recently. M. Loucheur, Minister of the Liberated Regions, stated, according to a consular report, that when the French recovered possession of the mines in the Departments of Nord and Pas-de-Calais, 140 shafts were found totally destroyed and the workings flooded, 2800 kilometres of gallery had to be re-established, and a volume of water extracted estimated at 110,000.000 cubic metres. There were 18,000 miners' dwellings completely destroyed, and 12,000 partly demolished. Eight hundred kilometres of railway tracks attached to the mines was destroyed, as well as power-plants with a capacity of 383,000 hp. M. Loucher estimated that the total cost of reconstructing the destroyed mines in the two departments will be from four to five billion francs. It will require almost ten years before the devastated mines can produce on a pre-war basis. In spite of the admirable work already done, thousands of dwellings must still be constructed, and about 100,000,000 cubic metres of water remain to be pumped out. By a law of July 31, 1920, special facilities were granted to industries, which have suffered as a result of the war, to float loans destined to permit reconstruction. In order to take advantage of this law, the damaged or destroyed mines in the north have combined to form the Groupement des Houillères du Nord et du Pas-de-Calais, a joint stock company with a capital of 50,000,000 francs.

SILVER DEPOSITS are found in Bulacan, Paracale, Cebu, Marinduque, and Mindanao, states a consular report. The establishment of a local mine would serve to stimulate interest in mining. Both China and India are on a silver-standard basis, thus assuring a near-by market for Philippine silver.

Conditions in Europe

By Lewis W. Douglas

The casual observer and traveler in Europe cannot but be impressed with two glaring conditions: a feeling of international suspicion, in cases almost approaching hatred, and, within nations, an attitude of unrest and uncertainty.

Two years ago, the eleventh of November, the most destructive and, certainly, the most costly war in the history of mankind came to an end—perhaps a tragic end. During the period of five years, in which entire nations were concentrating every effort on the ghastly business of killing, much more than material destruction was taking place. Old ideas, long held to be true, were being silently refuted; previously accepted conceptions were becoming no longer acceptable. Men were asking, and, if not asking, wondering "why" and "where", and "how" and "whence". People had had enough of the old order, and were eagerly searching for some new principle to which they might pin their faith.

And out of that chaos of thought there came a great idea expressed by a great idealist. He has made many terrible mistakes; for them he has recently been overwhelmingly denounced by the people of his own country, and yet withal, there is a quality of idealism about him which must eventually, if not now, assure him a seat in the gallery of the world's greatest men. That man, two years ago, and more than two years ago, enunciated a principle of international ethics which everywhere touched the spirit of man. The Armistice came. He went to Europe; he came, he saw, he conquered. Using his consistently most powerful weapon, he went over the heads of European diplomats and potentates. He addressed himself directly to the great mass of European peoples, and in turn he received a popular applause such as few if any men in history have been given to hear. He represented a great nation at a great peace conclave. Sitting alone among more than twenty-five warring factions, each schooled in the traditional diplomacy of secrecy, and subtlety, he drove through a principle of international conduct that, idealistic as it may be, impracticable as it is quite possible to be, appealed, if not to the crowned heads and premiers and Ministers of War, at least to the humble millions. And men thought "at last we have something that will tend to decrease the number of wars with their horrible toll of dead and wounded, and their annual drain on the resources of nations". And men knew that such a principle, supported whole-heartedly by a great moral people, must live and bear fruit. Then there happened unto them what befell the Lady of Shalott: the mirror was broken, their illusion was dissipated; for the United States, the enunciater and one-time acceptor of high principles, had repudiated her code. Like Cain she now said "I am not my brother's keeper".

Regardless of the possible tragic consequences to herself, the effect of that repudiation on European psychology was nothing short of tremendous. Lacking the moral support of a great nation, and lacking enthusiasm in her leaders, Europe has since reverted to the pre-war status of international feeling. France hates, or almost hates, England; England suspects France; both distrust Italy; Italy has no faith in either; and all are indifferent toward us. Germany is still beyond the pale; Russia is an unknown quantity; Poland has embarked upon a policy of aggression. The much advertised "solid front of the Allies" has been broken; France is saying, "We Allies are no longer united; go to, then; I alone shall enforce the Treaty of Versailles". Such is the international condition in Europe. The principles for which we fought, and which we opposed to those of the Imperial German government have been forced under. We, the conquerors, have been conquered by that which we conquered. Imperialism is rampant. The foundations of another war are being surely though unsuspectingly laid.

But though Europe has been foiled in her attempt to lay hold upon a new principle of international action, the awakening caused by the emotional reaction of war is still shown in her search for some new principle of internal action. France is perhaps the only nation that is not seriously affected. The reasons are quite obvious. The French, despite their light, life-loving, and perhaps frivolous, point of view, are a serious and logical people. And so, when some hundred and thirty-one years ago, led by a few men, some of whom were great thinkers, and some of whom were disgraceful characters, they decided that the medieval order must change, they set to with a will and literally wiped the slate clean. The French Revolution, bloody as it was, ghastly and terrible as it must have been, was the logical result of years of medieval rule imposed upon a post-medieval society. And yet through it and by it France laid the foundation of a sound economic order. The great landed estates—a medieval remnant—were broken up and distributed in small lots; political control by the few gave way to political control by the many. The burden of a landed aristocracy was once and for all removed. There were no half-measures. The past was obliterated. And out of that chaotic condition there emerged a new State, based upon a new political scheme.

The industrial organizations such as we have in this country, and such as England has in some measure, have never appealed to France. It is always both difficult and dangerous to catalogue causes and effects. Nor is this truism any less true in the present case. Suffice to say, therefore, that there are, at least, two factors which tend to discourage in France huge industrial enterprises. France is an old centre of culture; the thread of that

culture has never been broken; she therefore accepts life as something in which the mere making of money plays an important part—in the sense that one must live—though an insignificant one—in the sense that to live is not to make money. Her every effort, consequently, is not given to the accumulation of tremendous wealth. And the corollary is that she is not interested in those forms of organization which tend to amass huge fortunes.

The first factor which apparently influences France against the tremendous industrial development is one of philosophy. The other is a matter of economic conditions, for France has never been—God grant that she may never be—a highly industrialized state. Had it not been for the Franco-Prussian war and the imposition on France of the treaty of 1871, in which France ceded Alsace and Lorraine to Germany, she might today despite her tradition and philosophy be a great industrial as well as a great agricultural country, for in Alsace and Lorraine are the iron mines that since 1871 have made Germany what France has never been. The small producer therefore still survives in France. He, together with the peasant farmer owning property in his own name, constitutes over a half of the entire population. Under such conditions in which the employed class is relatively so small, bolshevism can gain little headway, for one of the conditions essential to blind radicalism is the existence of a large supposedly oppressed proletariat. And so France, in spite of a few sporadic efforts to arouse a spirit of rebellion, remains comparatively free from disturbing internal conditions.

England, on the other hand, presents a striking contrast. For years many have admired the English for their ability to shun extremes. One order has gradually replaced, or partly replaced, another. There has been little bloodshed; there have been few revolutions, and such as there have been since the seventeenth century have been small and, in themselves, unimportant. There is now therefore in England a medieval shell enclosing a highly industrialized modern organization. That shell must be, and undoubtedly will be, broken. But the question arises, will the process of breaking extend deeper than the shell?

Already there are indications of a coming change. For many years the development of labor organizations has gradually, but surely, proceeded, until today more than half the laboring population is joined together in combinations. Originally those combinations were formed for the purpose of economic protection. That purpose, however, has changed slowly until it has now taken on a political phase. Witness the progress and growth of the Labor party, originally organized for the representation of labor's point of view (now, however, misnamed, for it represents little more than the liberal point of view); witness the attitude which labor took in regard to Poland; lastly, witness the political issue at stake in the recent coal strike. And so it can perhaps be safely said that English labor organizations, consciously or sub-consciously, have assumed a new character, and that they have formed a new theory of control, political as well as economic.

The action of the coal miners presents a most interesting and, at the same time, a rather dangerous case. The situation was this: During the War, the control of the entire coal industry was transferred from the hands of the owners to the hands of the Government, and the power to regulate domestic and export prices for coal was vested, by Act of Parliament, in the hands of the President of the Board of Trade; wages, during the War, were increased in such a way as to make an addition to the original wage; and, further, twenty months ago the famous Sanckey Commission imposed, upon the original wage and the additions made thereto during the War, another award; the wage system in the coal industry is now therefore so complicated that a higher mathematician is scarcely capable of figuring accurately the total wage for each miner. The President of the Board of Trade set and changed the domestic price of coal several times, during the last few years, but sold the export coal at the highest possible price, the profits from which were to accrue to the Exchequer rather than to the owners in the form of profits, or to the miners in the form of wages. The miners objected to wars and insisted that the profits accruing from trade in export coal were being expended on the maintenance of a war force; further they objected to the principle of indirect taxation; in addition, they have been advocating for some time past the nationalization of coal mines. Such then is the background necessary to a complete understanding of the issues at stake in the coal strike. It is not necessary to point out that therein the miners have expressed themselves emphatically on certain questions of governmental policy, both domestic and foreign, and that by so doing they have taken unto themselves a new rôle.

The reason for this action is not solely an economic one, nor is it altogether a selfish one. Certainly on the part of some of their leaders and associates it is not a selfish one. Labor, or rather particular groups of the labor body, felt, perhaps justly, that those in whom political power is now, and has been for some few decades, vested have failed in their duty to themselves, the nation, and the world. They see old hatreds, old jealousies, old policies recurring; they see little if anything done in an endeavor to stem the tide of those hatreds, jealousies, and policies. And so they demand for themselves an opportunity to direct the government. It is that demand, implicit in the labor agitation of England, which makes the issues at stake in the recent coal strike not only one of two shillings or not two shillings, but also one in which Canada, South Africa, Australia, New Zealand, the British Isles, in fact, the whole Empire is involved, and one in which are implicit the questions of economic and political control.

What with the pressing, more pressing, and ever more pressing demands of labor, what with Ireland knocking at the door and insisting on an unsatisfactory settlement for a historically dissatisfied people; what with the final disintegration of the Empire looming on the horizon, we

cannot but extend across the ocean to the mother country —for after all England is our mother country—a feeling of sincere sympathy and a hope that, just as she has "muddled through" crises in the past, so will she muddle through the present one.

Of Russia, few if any persons are entitled to speak. A veil of secrecy and mystery enshrouds her. We hear of the Whites, the Reds, rebellions and counter-rebellions. We read one morning that the Lenin-Trotsky regime is about to totter and fall. The following morning the newspaper tells us that quiet reigns in Moscow and that the government, if there be such a thing, has successfully quelled all revolution. We are told that Russia is on the road to industrial and agricultural recovery, and within the hour we read of the chaos into which all things have been plunged. We know not whither to turn for comfort or truth. Of two things, however, we can be reasonably certain: The revolution of 1917 was engineered by the Prussians, who deserve no country, and it was executed by the Jews, who actually have none. But whoever engineered it, and whoever executed it, we can rest assured that something worth-while will eventually emerge out of it. Just as France in the eighteenth century developed out of her chaos a new workable system so will Russia in the twentieth. And that which develops will be like nothing that we know; yet will it stand the test implied in the question "does it work"?

Italy too has been torn asunder. D'Anunzio, Trieste, and Fiume are ever-present causes of irritation. And the historical cities of northern Italy in which during the Dark and Middle Ages municipal independence was first realized, again, in another form, are expressing a desire for what is disguised as freedom. Is there nothing new in the world? In Germany *Der Tag* is secretely still the toast, more popular than before, and, who knows, more possible of realization. Belgium is on the road to economic recovery. But there are dark clouds ahead of her, for there is taking place a substitution of intensive corporate enterprise for individual endeavor.

The Determination of Zinc by the Potassium Ferrocyanide Method

By E. Olivier

*The determination of the zinc in Australian concentrate is usually carried out volumetrically, either by the so-called American method (the potassium ferrocyanide method) or by the Schaffner method (titration of the ammoniacal solution with sodium sulphide); this latter method is also sometimes termed the Vieille Montagne method. In the American method the ore or concentrate is decomposed by means of nitric acid and potassium chlorate, the mixture evaporated to dryness, the residue boiled with ammonia and ammonium chloride solution, and the filtrate acidified; the copper is removed by means of lead foil, the liquid is neutralized with ammonia, a solution of potassium hydrogen tartate and ferric chloride is added, the solution heated to about 75°C., and titrated with standard potassium ferrocyanide solution in presence of ammonia until a spot-test with acetic acid shows a blue coloration.

The method used for preparing the solution for analysis results in the extraction of the zinc together with the copper, cadmium, calcium, and magnesium, and part of the lead, iron, and manganese. Of these elements only the zinc, copper, cadmium, and manganese are precipitated by the ferrocyanide, and only the copper is removed prior to the titration, so that the cadmium and manganese present are returned as zinc. Although the amount of cadmium present in the concentrate is usually so small as to be negligible (it averages about 0.1%), this is not so in the case of manganese, which may be present to the extent of considerably more than 1%, with the result that a high figure is returned for zinc. In one case, for example, I found 1.16% of manganese (as Mn_3O_4) in the zinc solution before titration.

That amounts of manganese such as are found in concentrate vitiate the titration is shown by experiments in which manganese corresponding to 2% and 4%, respectively, of Mn_3O_4 was added to solutions of known zinc content; on titration of these solutions 0.8% and 2.3% or zinc in excess of the quantity present was indicated.

To separate the manganese completely from the solution, a few cubic centimetres of hydrogen peroxide is added to the mixture of ammonium chloride solution and ammonia used to treat the residue resulting from the decomposition of the ore; this renders the manganese insoluble, and the results obtained agree closely with those found by the Schaffner method. When the percentage of manganese present is small (that is, 0.25%) the results obtained by the two methods (without the use of hydrogen peroxide) agree within about 0.1%, but in most cases manganese will be present in amounts sufficiently great to necessitate the use of hydrogen peroxide.

The American method has another disadvantage, especially where a large number of titrations have to be made daily: the titration is performed in hot solutions; this is necessary in order to obtain complete precipitation of the zinc ferrocyanide in a dense gelatinous form. Further, the blue coloration produced in the spot-test is not entirely satisfactory; the reaction is sensitive, but the color is not always distinctive in presence of colored ferrocyanides; the intensity of the color is not appreciably increased with increasing amounts of ferrocyanide.

In my opinion, the Schaffner method is preferable to the American method; the zinc precipitated as colorless sulphide, which affords a ready indication of its freedom from other metallic sulphides. The only other colorless insoluble sulphide known is the double sulphide of zinc and cadmium, discovered by me in 1886, but the error arising from this source is negligible because, as already pointed out, zinc ores contain very little cadmium; and, moreover, the greater part of the cadmium is separated as sulphide, together with the lead and copper.

*Abstracted from the 'Journal' of the Society of Chemical Industry.

THE PERMANENT TARIFF BILL

The Fordney Tariff Bill introduced in the House on June 29 contains provisions for the following duties:

Barytes, crude $4 per ton; ground $7.50 per ton; precipitated barium sulphate or blanc fixe, 1c. per pound; lithopone and other combinations or mixtures of zinc sulphate and barium sulphate, 1½c. per pound.

Manganese ore and concentrates in excess of 30% metallic manganese 1c. per pound of metallic manganese content; ferro-manganese 2½c. per pound of metallic manganese content.

Molybdenum ore or concentrates 75c. per pound on the metallic molybdenum contained. Ferro-molybdenum, all molybdenum compounds and alloys, $1.25 per pound of molybdenum contained plus 17% ad valorem.

Tungsten ore or concentrates 45c. per pound on metallic tungsten contained. Ferro-tungsten, tungsten powdered, all other compounds of tungsten, 72c. per pound on tungsten contained plus 15% ad valorem.

Bauxite $1 per ton; aluminum 5c. per pound; in plates, sheets, bars, etc., 9c. per pound.

Magnesium $1 per pound; magnesium alloys and manufactures $1 per pound on magnesium content plus 20% ad valorem.

Quicksilver 7c. per pound.

Nickel in pigs 5c. per pound; manufactured 30% ad valorem.

Tin in bars or pigs, scrap or granulated, 2c. per pound.

Lead ores and mattes 1½c. per pound on lead contained, with a proviso for the admission of 2000 tons of lead contained in copper matte free of duty each year; lead bullion, antimonial lead, scrap-lead, type-metal, babbit, solder or alloys or combinations of lead, 2½c. per pound of lead contained; lead in sheets, pipe, shot, etc., 2⅝c. per pound; lead acetate, white, 3¼c. per pound; brown, gray, or yellow, 2¼c. per pound; nitrate 2¼c. per pound; arsenate and resinate, 30% ad valorem; litharge, orange mineral, red and white lead 2½c. per pound; pigments containing lead 30% ad valorem.

Zinc-bearing ore, including calamine under 10% zinc, free; over 10 and less than 20% zinc, ½c. per pound of zinc contained; over 20 and less than 25% zinc, 1c. per pound of zinc contained; over 25% zinc, 1½c. per pound on zinc contained for the next two years. Zinc in blocks, pigs, slabs, old and worn out zinc, 2c. per pound; in sheets, plates, strips, fabricated or zinc dust, 2⅝c. per pound. Thereafter duties shall be as follows: over 10 and less than 20% zinc, ¼c. per pound of zinc contained; over 20 and less than 25% zinc, ½c. per pound on zinc contained; over 25% zinc, 1c. per pound on zinc contained. Zinc in blocks or pigs and zinc dust, 1⅜c. per pound; in sheets, 1⅝c.; in sheets plated, 1¾c.; old and worn-out zinc, 1 cent.

Graphite 10% ad valorem.

Fluorspar $5 per ton for one year; thereafter, $4 per ton.

Kaolin $2.50 per ton.

Antimony 1½c. per pound.

Mica 6c. per pound plus 17% ad valorem, unmanufactured 12c. per pound and 17%. Ground mica, 6c. per pound and 20% ad valorem.

Potash, for two years, 2½c. per pound on potassium oxide contained; one year thereafter 2c. per pound; one year thereafter 1½c. per pound; one year thereafter 1c. per pound; after five years, free.

Petroleum, crude, 35c. per barrel of 42 gallons; fuel-oil 25c. per barrel.

Magnesite, crude or ground, ½c. per pound; dead-burned and grained ⅝c. per pound.

The Bill will be vigorously debated in the House, of course, and it is expected that it will come to a vote within two weeks. It is not expected that there will be any changes in the Bill on the floor of the House.

COPPER QUEEN ADOPTS PLAN FOR EMPLOYEES' REPRESENTATION

An employees' representation plan, unique in its liberality, has been adopted by the Copper Queen Branch of the Phelps Dodge Corporation at Bisbee. The plan is modeled after the constitution of the United States, and delegates in the fullest measure to the employees themselves, the regulation of the conditions of their employment. An idea of the radical trend of the plan may be seen in Sub-section 10, Sec. 9, Art. 1, which declares that the congress (of employees) shall have the power "To pass such measures as may be necessary for the peaceful settlement of all differences arising between the employees and the company". It is clear that under this provision the employees may regulate the hours of their employment as well as their pay.

The plan was drawn up by the Employees' Conference Committee, and submitted to the management for approval. It was approved by the board of directors and the management of the company, conditional upon its being adopted by a large majority vote of the employees of the company, at a special election held for that purpose. This election was held on June 28, and the plan adopted by the affirmative vote of 82% of the employees.

In adopting the plan the employees are taking a big burden of responsibility upon their own shoulders. In taking into their own hands the control of their relations with the company they will necessarily acquire a more intimate knowledge of the business and internal affairs of the company. Under Section 11 the question of closed or open shop is done away with by the declaration, "The right to work shall not be denied to anyone because of membership or non-membership in any organization, the principles of which are not in conflict with the Constitution and the Laws of the United States and the State of Arizona."

In returning the plan to the employees for their action, G. H. Dowell, general manager, said in part:

"The plan submitted for your approval and adoption is modeled after the Constitution of our own Country, under which every individual is given an opportunity for advancement according to his ability and determination, and every citizen is given a voice in making the laws that shall govern him. So it is to encourage the individual employee in advancement, and to give him a voice in making the rules that shall govern his conduct, that we favor the adoption of the proposed constitution. I have often said that the interest of the employee and his employer are the same, and that

neither can succeed unless both succeed. Under this proposed constitution I believe we may have a fuller measure of co-operation, greater success and more complete satisfaction in our work."

UNITED STATES SMELTING DECLARES DIVIDEND

Directors of the United States Smelting, Refining & Mining Co. have declared the regular quarterly dividend of 87½c. (1¾%) on the preferred stock payable July 15 to holders of record July 8. The consolidated earnings for the first five months of this year are estimated at $872,497 after providing all interest. There have been deducted from these earnings reserves of $435,882 for depreciation and depletion and $131,065 for further exploration work in Mexico. These reserves aggregate in all $566,947 and leave estimated net earnings for the five months of $305,550, of which $84,219 was earned in the first quarter. The preferred dividend requirements for the five months' period is $709,260. The company's power supply in Mexico on which production depends has been substantially curtailed owing to a dry season. The rainy season now setting in will materially improve this condition. The demand for foreign silver has been sufficient to absorb the Mexican silver production and with any improvement of conditions in India and China increased earnings in Mexico may be hoped for.

MINERS STRIKE AT GRASS VALLEY

Failure of the operators of the Empire, North Star, and Idaho-Maryland mines and the Mine Workers' Protective League to agree upon a new wage-scale has halted virtually all mining in the district and 700 men are idle. The mines, however, are being kept unwatered. While George W. Starr, speaking for a group of operators, declared that negotiations would continue, William Southcutt, chairman of the scale committee of the workmen's league, stated that there was no immediate prospect of resumption and that the league had no proposals before it. The reduction of $1 per day in the wage-scale announced on June 2 to become effective on July 1 would make the wage for miners $4.62½ per day, while that for shovelers would be $4.25. The operators stated in making the announcement that the mining problem in Grass Valley had resolved itself into a question of lower operating costs or abandonment of the mines.

The workers replied with a rejection of the proposed new scale and a criticism of the operators for making the announcement through the press before laying it before the miners' organization. A step in the direction of a settlement was started on June 19 when the workers proposed that the reduction be made 50c. per day instead of $1 as at first intended. The operators replied that they could afford to pay only the scale originally announced and that the mines would close if the $1 cut was not accepted. The old scale agreement expired on June 30 and the miners refused to go to work under the operators' intended scale.

SALE OF STANDARD MINE IS RATIFIED

The Standard mine, at Silverton, B. C., which contributed millions of dollars to its stockholders in the past, is to be sold for $75,000. Negotiations for its sale were opened by the board of directors of the company several weeks ago and ratified by the stockholders at a recent meeting at Spokane. The property will pass to New York people under a bond and lease which must be exercised within 30 days. The identity of the purchasers has not been revealed. Their acquisition will include mining claims, mill, tramway, dock, and all other improvements. The transaction will leave the company without a mine, but with a surplus of $250,000 to $300,000. This money will not be disbursed, but will be retained for the purchase and development of another property if it can be found. Several properties have been examined. "We sold the mine because we believed it was worked out," said an official. "The Standard was believed to have been worked out on three occasions, but as often new ore-shoots were uncovered by persistent operators. Its dividend yields aggregate $2,700,000 made under the Finch & Campbell management, a sum that is raised to $3,000,000 by the surplus."

DOLORES ESPERANZA CORPORATION RE-OPENS MEXICAN MINES

The properties of the Dolores Esperanza Corporation in Mexico, formerly owned by the Mines Company of America, which have been closed down for nearly eight years, are being re-opened. During the ten years from 1903 to 1913 the properties comprising Dolores Esperanza disbursed nearly $5,000,000 in dividends. They were forced to close down in 1913. An effort was made to keep the mines open, but this proved very expensive, with the result that in 1918 the old company found itself not only with a depleted treasury, but in debt to the extent of $500,000. The Dolores Esperanza Corporation was then formed to take over the properties. It has issued and outstanding 864,802 shares, par value $2, which shares were underwritten at that price.

The Dolores mine, in Chihuahua, one of the group, has been unwatered, and development work is being carried on. Development work in the El Rayo is progressing satisfactorily.

The Dolores Esperanza Corporation now has approximately $400,000 of cash or the equivalent thereto, and no debts.

SCALE OF OPERATIONS AT THE GARFIELD SMELTER IS INCREASED

The Garfield Smelting Co. has increased operations and is now smelting 500 tons of ore per day, as a result of working out a high-silica smelting charge. This has rendered it possible for a number of the Tintic properties to increase shipments of silicious silver ore, and also has enabled the Bingham Mines Co. and the Montana Bingham Mining Co. to find a market for their copper-iron sulphide fluxing ore. The silica content of the slag at the smelter is said to average about 48%, and this is believed to be the highest silica slag made by any smelter in the world. Before working out the new charge, the company made a slag averaging 40% silica. The Engels Copper Co. in California is shipping a high-grade concentrate, which, with scattered small shipments from various places, enables the company to operate two reverberatory furnaces and one converter.

SALES OF COPPER

The brisk business done by the Copper Export Association in the first five months of this year, fell off sharply during the latter part of June. In the period from January 1 to June 1 approximately 109,000,000 lb. of metal was sold for export at an average of 12⅞c. per pound, a large percentage of it being contracted for in May. Since then, however, business has dropped off. England and Germany have ceased to inquire for large amounts of copper; 1,000,000 lb. was sold recently for 13c. per pound for shipment to England, but this was the only sale in the million-pound column for some weeks. Domestic demand is the same as it has been—for small amounts and with no buyers contracting for future delivery. There are today only about four leading mines producing copper. Toward the latter part of July the American refineries will have worked off the metal now being treated and there will then remain only the South American mines and the quartette of domestic producers shipping to the Eastern reduction works. This outlook for reduced pro-

duction, however, has failed to influence domestic consumers. They cannot be stampeded into buying ahead of immediate wants, as they know today there is over 850,000,000 lb. of raw and refined copper above ground, of which over 600,000,000 lb. is ready for immediate delivery.

CALIFORNIA

Agua Caliente.—The Royal Flush property is owned by C. W. Chilson and J. O. Percival. Two ore-shoots outcrop at a distance of 120 ft. A tunnel tapping No. 2 ore-shoot at a depth of 55 ft. cut a 'pay-streak' averaging 7 in. wide. Samples taken assayed from $81 to $286. The latest development is a drift 20 ft. from the bottom of an 80-ft. winze; it discloses a full face of ore. The district has a good record for gold production.

Angels Camp.—The Victor Land & Mineral Co. is drifting for the west channel in its mine. At present work is in a good grade of gravel, below the rim. A new method of clean-up is being used, the material in the boxes being cleared of pebbles and light sand, the gold being left in the black sand, which is treated by amalgamation. The method is quick, efficient, and cheap and removes all the gold and platinum. Cleaned black sand from previous clean-ups has yielded bullion in excess of $4 per pound treated, in gold and platinum.

Bishop.—Operations have been resumed at Bishop Creek gold property under supervision of Gaylord Wilshire. The management states that as soon as the workings have been placed in shape for production, from 30 to 50 men will be employed. The property is well equipped and has yielded some excellent ore.

Downieville.—The Wisconsin Mining Co. has found gold-bearing gravel on the old Parkman ground. Work done so far indicates a large deposit of profitable gravel.

Forest.—E. H. Graham, of Grass Valley, has brought 10 millwrights to begin the erection of the 10-stamp mill of the Kate Hardy Mining Co. and to erect other buildings. The ore-bins at the mine are full and development work is progressing satisfactorily.

Glencoe.—A discovery is reported at Glencoe on the Stoetzer ranch, by A. J. Bayless. The vein is reported to be 18 in. wide, the ore assaying from 5 to 10 oz. in gold.

Grass Valley.—A raise from the 400-ft. level of the Alcalde mine has been started. This raise, which will reach the surface, together with a winze sunk at the same point, will form a vertical shaft to replace the old incline.

Jamestown.—The Eagle-Shawmut company is employing 23 men cleaning-up and sinking its main shaft.——The Clio mine is erecting new houses for the staff.

Jackson.—The water in the Kennedy mine has been lowered to within 50 ft. of the bottom. This will not be pumped out at present. Extensive repairs are being made in the shaft-timbering, and the company hopes to be ready to produce regularly by August 1; 42 men are employed.

Melones.—The Patterson mine has contracted for a mill of 20-stamp capacity. This mine has been doing exploration work for the past two years and has developed a large block of ore which it is now proposed to mill.

Nevada City.—Pay-gravel has been found in the Penn-California mine in Willow valley, according to A. W. Hoge, the manager. The discovery was made in a raise recently driven about 100 ft. vertically. Hoge states that the gravel prospects well, but that through a miscalculation the channel was penetrated on the rim instead of near the centre as intended. The centre is supposed to be 40 or 50 ft. lower than the rim and to contain much richer gravel. Hoge says that in addition to the two miles of channel owned by the company, two promising lodes have been cut. A drift will be run on one of these to get directly beneath the gravel channel.

The Old Anchor Tunnel at Park City, Utah

Quincy.—The first clean-up at the Australia placer mine was made last week; 41.56 oz. of gold was obtained. This does not come up to expectations, but considerable dead work in the building of flumes, ditches, and boxes has been completed and the company is very optimistic about the future results. The mine is situated about 12 miles from Quincy on the old Erickson claims.

The Mason Valley smelter interests are developing their property, leased from J. E. Murphy and R. Barnes and situated about eight miles from Genesee. They are drifting on the ore and have already completed about 125 ft. of the tunnel. It is planned to cross-cut both ways at a distance of 150 ft. from the portal. Chris Smith is superintendent in charge of the property.

Scales.—Preparations are being made by H. L. Berkey for making a final clean-up from his hydraulic operations near here that were begun last November.

COLORADO

Boulder.—An important find has been made on the Bluebird mine of the North Boulder Creek Mines Co., in the Caribou district. A vertical vein in contact with a strong

porphyry dike has been opened, that samples as high as 425 oz. silver per ton, in the Santa La Saria tunnel. The company's 50-ton flotation mill is reported operating steadily and, concentrating 30 to 1, is saving better than 90% of the silver-lead content of the ore. Eastern capitalists are interested.——Lessees on the Caribou continue mining a good grade of ore. Chicago men have become interested in a lease on this property and the extension of the present tunnel, now in 6000 ft., is planned.

Breckenridge.—Placer production in Summit county promises to increase as operations are being extended to properties not worked since before the War. The Washington placer is active and one 'giant' is tearing down the high bar for Charles Siessler and son. The Carpenter placer at the head of Nigger Gulch will be prospected and the Tonopah Placers Co. has its big dredge operating. Other dredges are being put in condition for the season's work.——Seepage water from melting snows has temporarily stopped operations at the 300-ft. level of the 'Deep Shaft' by the Tymes company, and a pump has been ordered. The Tymes was cross-cutting to cut the Brooks-Snider and Ground Hog veins believed to extend across Tymes territory.——The Royal Tiger Mines Co. is maintaining operations at full capacity under John A. Traylor, manager. Lead carbonate ore containing gold and silver is being shipped to the A. V. smelter at Leadville by lessees of the Price, Standard, and Missouri lode properties.

Central City.—A committee of the Metal Mining Association of Gilpin county is working to secure a sampling plant for this district. Sufficient funds seem to be assured for the erection of a plant. Returns from a 20-ton shipment from the Frontenac mine gave $85 per ton in gold, silver, and copper. Lessees are opening stoping ground and will shortly increase production.——The Midwest M. & M. Co. is mining a good grade of ore from two parallel veins in the Cyclops tunnel workings in the Hughesville district.

Cripple Creek.—Operations have been resumed by the War Eagle Consolidated Mines Co. from the 1100-ft. level of the Blue Flag-Silverton shaft. A contract has been let for extension of the lateral to a point directly under the Scott or main shaft, when connection will be made by raising. The Moffat tunnel, connecting with the Blue Flag workings, is to be extended north-east through the Sheriff, thence to the Amanda and War Eagle. A cross-cut will also be carried from the Blue Flag through the Bogart and Happy Year holdings of the War Eagle company. Tully Scott of the Colorado Supreme Court is president of the War Eagle company.

Lessee Fish of the Vindicator Consolidated, operating a block of the Golden Cycle mine, extending from 600-ft. level to the surface operating through the Longfellow shaft on the Stratton estate, has opened what is believed to be the south-western extension of the rich Hayes ore-shoot. A drift has been carried about 50 ft. on a good grade of ore, with rich seams of sylvanite in four to six feet of vein matter. The ground to the surface is virgin and the lease, should the shoot extend upward, will be a fortune-builder.

Idaho Springs.—High-grade silver-lead ore assaying as high as 200 oz. silver and 45% lead has been opened in a vein 2½ to 5½ ft. wide on the property of the Blue Ridge Mining Co., in the Montana mining district, south-west of Dumont in Clear Creek county. The ore was cut by the Upper West tunnel. The company is also developing its Happy Thought and Albro Hill groups, in the Morris and Fownieville mining districts, by extension of the Hiawatha tunnel, now in 1400 feet.

Leadville.—The Best Friend mine in the Big Evans gulch section, inactive for the past 10 years, has been leased by local operators who plan to extend the 2000-ft. tunnel to prospect unexplored territory.——The Long & Derry mine, an old Iowa Gulch producer, has been leased for a long term to James McMullen, who recently returned from Montana. ——The Fidelity Mines Co. has resumed operations in the Twin Lakes district. The property, situated on a spur of Mt. Elbert, is producing ore from a three-foot vein assaying $87 per ton in gold with about five feet of $7 mill-ore in addition.

Silverton.—The Gnome Mining Co. has a crew engaged to resume development on its properties near Animas Forks. ——The Highland Mary mine in Cunningham gulch, has been leased to local operators and shipments will soon be resumed from the property.——The mill and tramway at the Liberty Bell mine are again operating to clean-up and treat a big block of ore "found sealed up" after the mine was closed-down last April. Power is furnished from the Deer Trail pipe-line and the mill will be kept in operation until the ore is exhausted.

IDAHO

Bonner County.—The Carpie Mining Co., owning a copper property at Cabinet, is installing a new hoist and compressor, and will sink the shaft from the 300-ft. level to 1000 ft. The vein on the 300-ft. level is said to be six feet wide in the face of the drift.——A 10-in. vein of silver-lead-copper ore averaging $105 is reported by W. M. Hollenback, of the Falls Creek Mining Co. on Pend Oreille lake. This company has a 50-ton concentrator, a water-power plant, and other equipment; it intends to add flotation to save the silver.——A streak on the surface of the American Eagle Mining Co.'s property returned 112 oz. in silver and 48% lead. The values come from a contact vein along a dike about 100 ft. wide. The vein is from two to eight feet wide. About 1400 ft. of development work has been done.

From the Bluebird mine lessees are shipping gray copper ore that is said to run from 400 to 1500 oz. in silver. A small carload was shipped two months ago; another is being loaded. The Bluebird adjoins the Armstead mine.——At Clarks Fork a long tunnel is being driven by contract on the property of the Clarinda Copper Mining Co.——Spokane people are largely interested in the Lawrence Mining & Milling Co. at Clarks Fork. The company's lead ore is said to be rich. Joseph Reed is manager.——At Hope a small force is working the property of the Hope Mining & Milling Co. Copper, silver, and lead are contained in the ore.

Coeur d'Alene.—A drift on the deep level of the West Hunter mine at Mullan lacks 200 ft. of a point where it will under-cut the shoot showing on the surface, according to Edward T. Davy, president. A vertical depth of 1000 ft. will be attained. A distance of 850 ft. has been driven from the American Commander tunnel through which entrance to the West Hunter is obtained.

Three feet of high-grade ore, said to be the best yet found in the property, was opened recently by lessees in the lower workings of the Western Union Mining Co. It is expected to assay well in silver. These lessees are loading another 50-ton car for shipment to the smelter. Other shipments have averaged 50% lead and 44 oz. silver.

Moscow.—Although there are not more than a half-dozen heavy producers in Shoshone county, which includes the Coeur d'Alene, the Government report shows that 39 properties, large and small, contributed to the total tonnage in 1920. Idaho county had 18 small producers; Clearwater, 5; Bonner, 3; Latah and Benewah, 2 each; and Boundary, 1. The one in Boundary was the Idaho-Continental, which had an output during the year of $348,138 more than the production of all other counties of northern Idaho combined, except Shoshone county.

KANSAS

Baxter Springs.—Mining operations in this district are getting in shape to be able to take advantage of any improvement in the ore market by sinking shafts and putting

their present properties in condition where they can be run at capacity when the market improves. O. M. Billharz and associates are sinking a shaft on the property situated about a mile west of this city on the Chetopa road, known as the Hartley homestead. The derrick has been erected, work on the hole is progressing rapidly. This is the property on which a sensational find was made a few weeks ago.——The erection of a big mill on the Brewster land, just west of the Hartley homestead, is well under way. This is being built by the Chanute Smelter Co. The same company is making preparations to erect a mill on the Karl Ebenstein land, which adjoins the Brewster claim.——The Rakowsky-Billharz people also will have a mill on the W. T. Hartley property, just west of the R. F. Hartley mill and J. H. Goodwin and associates have everything ready for a mill on the race-track grounds.

MICHIGAN

Houghton.—Equalization valuations of the Lake Superior copper mines, which are based on the market values of the respective shares, show an average reduction this year of 30%. These have been determined in other years in October, but under a new Michigan law will be fixed in June hereafter.

The total equalized valuation for Houghton county, the greater part of which is in mining property, is $64,081,653 as compared with $91,878,050 last year. Calumet township, in which Calumet & Hecla is located, shows a reduction of nearly $10,000,000; Adams township, which includes the Copper Range mines, is reduced $7,500,000; Quincy, $1,000,000; Franklin, $1,000,000; Osceola, $2,000,000; and Portage, in which is located Isle Royale, $2,000,000. Keweenaw county's equalization values have been fixed at $16,000,000, which compares with $21,000,000 last year. The greatest reduction was made in Allouez township in which the Ahmeek and Mohawk mines are located. The tax rates will not be set until fall. It is known they will be higher than last year but the mining companies still will benefit somewhat as a result of the reduced valuations.

With the exception of a few small orders for domestic delivery, there is little inquiry for metal and there have been no shipments out of the district in the past week. While Mohawk and Wolverine continue to produce at capacity, sending a total of 3500 tons of rock to the mill daily, Copper Range is still on a 60% basis and Quincy is barely keeping open with production one-third that of normal years. Calumet & Hecla is operating only 5 of its 24 furnaces. It has only a small quantity of mineral on hand at the smelters and only enough cupola blocks to keep the plant in operation another month. When this supply is exhausted there will be no necessity for continuing unless special orders for metal are received in the meantime. The smelters are turning out anodes from cupola blocks and cathodes that are returned from the electrolytic plant are either smelted into bars or ingots or held in reserve for re-smelting into special shapes.

It is unlikely that the reclamation plant, to be built on the Tamarack conglomerate sands by Calumet & Hecla, will be started this summer although steel and other material, ordered before the depression in the industry set in, has been arriving at the site. There are 12,000,000 tons of sand in the Tamarack deposit, carrying from 10 to 12 lb. of copper to the ton, which was laid down in Torch Lake at a time when milling processes were not perfected to the extent they are today and the losses were comparatively large. This copper can be recovered at a cost of not more than seven cents per pound, exclusive of smelting and selling costs.

MISSOURI

Joplin.—A semi-official survey of the Tri-State zinc and lead district reveals the fact that more than 40 mines have been operating on full time and several others on part time. In addition to this several mills are treating tailing. This is a larger number than had been currently reported but this is believed to have been due to the fact that several milling concerns are operating two plants each and that the first survey had reference to the number of companies in operation. Some of the plants are expected to close down this week.

NEVADA

Goldfield.—The Silver Pick has started stoping the ore opened recently in the lease of that company on the Red Top of the Consolidated. This ore was found 100 ft. into the foot-wall of the vein, at a depth of 265 ft. It is in entirely unexplored territory. The vein lies rather flat and apparently has a general strike north-west from the main ore-channel. A width of 10 to 20 in. on the hanging wall assays $150 to $800, but the ore as broken for shipment, from about half the drift, assays $50 to $150. The shoot has

The Telluride District in Colorado

been opened for a length of between 40 and 45 ft., without the end being reached and work has been started to explore for it on th 365-ft. level. This work is being done less than 100 ft. from the Red Top shaft, but as the machinery has been removed from this shaft, hoisting is done through the Laguna shaft, which is well equipped. Because of the position of the ore far into the foot-wall and the strike of the vein the find is regarded as the most important made in the district in recent years.——Donald and Giles, lessees on the Florence, have exposed for a length of 18 ft. the rich ore found by them in the hanging wall of the old Reilly flat stope at a point 40 ft. above the 160-ft. level, and they have started stoping. The ore being broken for shipment in bulk assays $300 to $400. The first 10 tons of this ore assayed $360. The rich widths on the foot and hanging wall continue and the gouge between is increasing in value. It is possible for the ore to have a length of 70 ft. and to extend to the surface. The stope in which this ore was found caved in the early days and had not been entered from then until Donald and Giles raised more than 50 ft. into the foot-wall.

The shaft of the Deep Mines is 650 ft. deep. At 515 ft. it passed from the andesite into the latite and, except that the C. O. D. and Victor veins should be cut before the 1000-ft. level is reached, no further change is anticipated. The main vein system is at 2400 ft., in the latite near the latite-

shale contact. The shaft is 5 by 17 ft. in the clear and it consists of three compartments, two 4½ by 5 ft. for hoisting and one, 5 by 7 ft., for the pipes, electric cable, and ladders. The ventilating-pipe, 2 ft. in diameter, extends to the top of the head-frame and a suction ample to ensure good air at the bottom of the shaft is obtained by the natural heating of the upper length by the sun. Three stations will be established, at 800, 1600, and at 2400 ft. The water from the bottom will be pumped to the surface in three lifts, 2400 to 1600, 1600 to 800, and 800 to the surface.

Silverhorn.—Dan Foley has opened ore in several new places in the vein he recently discovered in the south-eastern end of the district and he reports assays ranging from $11 to $743 per ton. New work was started during the week on the Silver Carlisle group, located east of the Silver Peer and controlled by New York men. Robert Mulford, Frederick G. Corning, C. V. R. Cogswell, and Sidney Green, all of New York, are directors with Theo. Crampton, managing director at the mine.———In the north cross-cut on the 50-ft. level of the Huson shaft on the Silver Dale the lode was 10 ft. wide at last reports and assayed from $12 to $30 per ton.

Tonopah.—The Belmont company's mill, the largest reduction plant at Tonopah, has resumed operations on a 50% capacity schedule. This is the first time the Belmont mill has turned a wheel since the mine strike was declared nearly two months ago. The Tonopah Extension's mill has been in operation for a fortnight. It also is running on a reduced schedule, but the mine owners expect to increase operations as the importation of new men into the camp continues.

It is said that the Belmont now is employing 170 men and over 100 men are at work at the Extension. These are the two largest properties in the Nye County camp.

No attempted disturbances have been reported since the arrival of the State police and the authorities expect no further difficulties.

UTAH

Alta.—Ore shipments from this district are averaging about 150 tons per day. Shipments are coming principally from the Columbus-Rexall and the South Hecla properties, each of which will average 50 tons per day within the near future. The Michigan-Utah mine is now making shipments. A new cable has been installed on the tramway from the mine to Tanners' Flat, and a spur of the Little Cottonwood railroad has been built to the ore-bins at the tram-terminal to avoid hauling by team. At the Sells property four or five carloads of ore are ready for shipment.

Bingham.—Twenty miners have been added to the working force at the Bingham-Galena property, formerly known as the Silver Shield, according to H. S. Joseph, a director of the company. Shipments are being made to the United States smelter at Midvale, averaging $2 in gold, 10 oz. in silver, and 15% lead. The ore is coming from the Bully Boy group. Eugene Grutt has been appointed general superintendent of the mine, under O. F. Brinton, consulting engineer.

Delta.—R. H. Evans and associates have resumed work at the Purdy-Evans mine in the Sawtooth mountains, about 50 miles south-west of this city. Development work was begun in April, but owing to a dispute with A. B. Knowlton, who claimed to have prior rights, the question of ownership was investigated and Evans and associates were found to be the lawful owners. Development was started on the Last Chance No. 1, 2, and 3 claims. A body of molybdenum ore was opened which assays from 15 to 19%.

A large deposit of strontium carbonate ore has recently been discovered in this vicinity by F. L. Byron and Daniel Potter. It is stated that the deposit has been opened for a distance of nearly a mile, with a width of 600 ft. and a depth of about 200 ft. It occurs in two forms; one hard and crystalline, and the other fibrous and soft.

Eureka.—During June, approximately 150 men were added to the working forces of local mines, with the result that there is practically no unemployment of miners in this district. The greater part of this number has been employed at the Tintic Standard and Eagle & Blue Bell properties.

Output of ore from this district is increasing, owing to several of the mines having received permission to ship silicious silver ore to Salt Lake valley smelters. During the week ending June 25, the Tintic Standard shipped 46 cars; Chief Consolidated, 42; Iron Blossom, 14; Eagle & Blue Bell, 12; Dragon, 8; Iron King, 7; Victoria, 5; Gold Chain, 4; Swansea, 3; Gemini, 2; Eureka Bullion, 1; Mammoth, 1; making a total of 145 carloads, the heaviest in many weeks.

A shipment of ore from the Eureka Bullion mine during the latter part of June averaged 25 oz. silver and 15% lead. This is the best ore yet found at that property, according to J. M. Bestlemeyer, manager.

At a meeting of the directors of the Chief Consolidated Mining Co. on June 30, a dividend of 5c. per share was declared, payable August 1. This is the third dividend to be paid this year and will aggregate $44,201, bringing the grand total up to $2,004,122.

Frisco.—Regular shipments are being made from the Quad Metals mine, according to Grant H. Snyder, manager. This ore, a high-grade silver-lead sulphide, is being mined on the 700-ft. level. Smelter returns on two carloads shipped recently netted the company $1700 and $2800.

Park City.—The largest output of ore in many weeks was made by local mines during the week ending June 25, when 1755 tons were shipped. Shipments are being increased by the Silver King Coalition, and the Naildriver property has again become a shipper. The Silver King Coalition shipped 661 tons; Judge companies, 579; Ontario, 335; and Naildriver, 180. Shipments during the previous week totaled 887 tons.

Salt Lake City.—The assessed valuation of metal and coal-mining property in Utah for 1921 is $64,232,112, as compared with $61,598,942 for 1920. Salt Lake county, in which is situated the Utah Copper property, heads the list with a valuation of $32,254,757, or slightly over one-half of the grand total. The State constitution requires that all mining property shall be assessed by the State Board of Equalization; that metalliferous mines shall be assessed at three times their net proceeds for the preceding year, plus the value of real estate at $5 per acre, plus the actual cash value of machinery, mine buildings, and other surface improvements. Non-metalliferous mines are assessed by the State Board at a valuation to be determined by it from a study of the probable deposits.

The annual meeting of the Rocky Mountain Coal Mining Institute was held in this city on June 28 and 29. Four States were represented—Colorado, Wyoming, New Mexico, and Utah. The coal-men attending the convention represented mining companies which produce annually about 40,000,000 tons of coal. One of the features of the meeting was the reading of a paper by A. C. Watts of the Utah Fuel Co. on 'Fighting Mine Fires'.

Tooele.—The International smelter suspended operations entirely on July 1, for an indefinite period. The copper department of the plant was closed down last autumn, but for the past few months two of the five silver-lead blast-furnaces have been operated. Lack of ore was given as the reason for the closing. About 300 men will be thrown out of employment as a result of the shut-down.

SOUTH DAKOTA

Lead.—The Homestake Mining Co. has issued a second dividend of 25c. per share. The first dividend since March

1919 was declared on May 25; the latest, on June 25. Decreased operating costs resulting from lower wages and lower prices of supplies, together with increased efficiency of mine labor, have made the resumption of dividends possible.

BRITISH COLUMBIA

Greenwood.—The first shipment of the year from the Providence mine has been made to the Trail smelter. Between 35 and 40 men are employed at the mine, and from now on it is expected that weekly shipments will be made. The ore contains gold, silver, and lead; 338 tons that was shipped in 1919 yielded 267 oz. gold, 38,903 oz. silver, and 7616 lb. of lead. Treatment charges and freight cost about $11 per ton.

Kaslo.—A. J. Curle has uncovered a promising new vein on the Kirby property. The vein is well mineralized and ranges from 25 to 35 ft. in width. Last year Curle discovered a 13-ft. vein on this property, assays from which have run from 25 to 2000 oz. in silver; the vein is being developed by a shaft. The property adjoins the Bluebell mine, which shipped steadily to Trail last year.

Princeton.—Bert Powell has bought the Condit brothers interests in the Horn Silver mine, in the lower Similkameen valley, and now is sole owner of the property. Several shipments have been made from the mine this year, but Powell now purposes to try to interest capital for the purpose of erecting a small reduction plant at the mine.——The Tulameen Mines Operation Co. is getting out lumber for the erection of a flume at Bear creek, where the company purposes to operate placer deposits for the recovery of gold and platinum. The best specimens of placer platinum that have been found in British Columbia have come from tributaries of the Tulameen river.

Stewart.—The Linderbourg brothers, of Hyder, have started to develop their property at Seven-mile, where there is a large body of medium-grade ore. A tunnel that has been driven for 340 ft. is to be extended.——The Fish Creek Mining Co. has re-started the development of its property on Fish creek, on the Alaskan side of the international boundary.

MEXICO

Torreon.—La Pluma, a group of ten silver-lead mines, situated in the San Lorenzo mountains near Matamoros, has been taken up by Jesus Rodulfo and associates, of San Pedro. Development work is being carried on. Several other promising properties are being filed on in this district.

Durango.—Gen. Enrique R. Najera recently located a group of seven pertenencias in the Avino district. The claims adjoin the Socavon, Bolso, and Cuatro Amigo mines. General Najera acts as Governor of the State when Governor Agustin Castro is absent. He has extensive land and mining interests throughout the State.——The old Cedro mines in the Escobar district have been re-located by Abdon Alanis of Tepehuanes and will be patented under the title of San Luis. These properties are producers of gold and silver and were recently declared forfeited for non-payment of taxes.

Guanacevi.—Herald McLeod Cobb is exploring the San Valentine mine in La Luz mountains. This property lies contiguous to the old Veta de Oro mine which has produced an abundance of rich ore.——The old Ofelia group of mines in the neighborhood of La Violeta and Veta Grande groups has been filed on by Charles Suayfeta.——Another recent filing in this district has been made by Manuel Bolivar, who has applied for titles to a group of three claims to be titled under the name of Cabadena. It is situated near the San Francisco and Isaura mines, which are gold, silver, and lead producers.

ONTARIO

Elk Lake.—The hematite iron deposit recently discovered in Morel and Yarrow townships, is being explored by the owners, and it is stated that the result points to a large body of ore. Another outcrop of high-grade hematite is stated to have been discovered in the vicinity. These discoveries have stimulated prospecting and a large number are engaged in the work.

Kirkland Lake.—Much new capital is seeking investment in this field, where many mining engineers representing important interests are making investigation.——The White-Kirkland Gold Mining Co., capitalized at $500,000, in which Cleveland, Ohio, men are interested, has secured a property of 130 acres and will shortly begin development.——The Lebel Lode, Ltd., has been incorporated with a capital of $2,000,000, to develop three claims aggregating 100 acres north of the Lebel Oro and the King Kirkland, on which veins have been found showing good gold content on the surface.——The Wood-Kirkland has a force of men engaged in surface work. A plant will be installed before winter for underground operations.——The Ontario Kirkland has placed an order for electrical equipment for their mill to cost $22,000.——The Lake Shore during May produced gold to the amount of $29,637 from the treatment of 1865 tons of ore, being an average recovery of $15.88 per ton. Harry Oakes, the president, states that the matter of enlarging the mill has for the present been left in abeyance.

Larder Lake.—A Toronto syndicate headed by S. J. Thomas has taken up options on seventeen claims and has eleven more under options. The plans of the syndicate are to some extent dependent upon the construction of the projected light railway.

Porcupine.—Owing to the increased activity in gold mining, the town of Timmins is overcrowded with people who are unable to find house accommodation and are obliged to find shelter under canvas. The present building program appears inadequate to meet the requirements of the coming winter. A scheme for the formation of a company to build a number of small houses for sale is under consideration. ——The McIntyre will close one of the most prosperous years in its history on June 30. It is understood that the annual statement will show profits in the neighborhood of $1,000,000 before providing for depreciation, and that the grade of the ore has been well maintained at around $11 per ton.——Preliminary work is being done on the Big Dyke, formerly the McRae Porcupine. The company has secured an option on the Pike Lake property adjoining.

South Lorrain.—The mill of the Keeley has been put into operation and good results are officially reported. A good concentrate is being produced at the rate of 1½ tons per day and a substantial amount of high-grade is being cobbed for shipment.

West Shining Tree.—The Wasapika Consolidated has a large amount of high-grade ore in sight. The vein has a width of 25 ft. on the 200-ft. level and there is much ore that can be worked from open-cuts. The management has decided to proceed immediately with the construction of the first 50-ton unit of a 200-ton mill.

QUEENSLAND

Cloncurry.—An important deposit of cobalt ore is being worked 20 miles south of Selwyn. Four shafts have been sunk on the lode, to depths varying from 20 to 112 ft. The lode, as exposed, is 4 to 5 ft. thick, and extends along the surface for upward of 300 ft. The assay is about 6% cobalt, with no other valuable metals. A trial shipment of 50 tons of ore has been sent to England. A small crushing and concentrating plant is to be erected.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

P. B. McDonald is in London.

Howard D. Smith is here from New York.

J. Parke Channing recently visited Miami, Arizona.

Galen H. Clevenger has returned to Boston from Mexico.

Lyman F. Barber is at Los Angeles, where he will spend the summer.

James S. Douglas has returned from France and is now at Jerome, Arizona.

W. H. Blackburn, of the Tonopah Mining Co., is in San Francisco for a week.

W. V. Griffith has moved from Christmas, Arizona, to Geyserville, California.

E. J. Franklin, mechanical engineer for the Ray Consolidated Copper Co., is at Chicago.

R. L. Beals is general superintendent for the Shasta Zinc & Copper Co., at Bully Hill, California.

Samuel W. Traylor was married to Miss Lottie Greenwood Lakel on June 24, at Allentown, Pennsylvania.

Edwin Higgins has gone to Telluride, Colorado. He will visit Michigan before returning to San Francisco.

John V. Richards is in eastern Oregon for the summer, in charge of a field party of the Oregon Bureau of Mines.

Edgar N. Rhodes has been appointed president and general manager of the British America Nickel Corporation.

Charles Bocking, manager for the Butte & Superior Mining Co., has returned to Butte after a trip to Eastern cities.

William T. MacDonald, mill superintendent for the Moctezuma Copper Co., at Nacozari, Mexico, is at Salt Lake City.

R. E. Howe and **A. D. Wilkinson**, of the Greene Cananea Copper Co., Sonora, Mexico, were in San Francisco recently.

H. Steele has gone to Mexico City to take charge of the enterprises of the American Metal Co., Ltd., in that country.

Brent N. Rickard, assistant superintendent of the A. S. & R. smelter, at Murray, Utah, is on a vacation at Fish Lake, Utah.

J. C. Kinnear, smelter superintendent for the Nevada Consolidated Copper Co., was in San Francisco on his way from Los Angeles.

Stuart G. Taylor, treasurer for the Judge mining interests at Park City, Utah, has returned to Salt Lake City after a vacation in Los Angeles.

Alan M. Bateman has gone to Alaska to report upon the exploration and development of the properties of the Kennecott Copper Corporation.

J. B. Jensen, mining engineer of Salt Lake City, is making an examination of shale deposits for the Standard Shale Products Co., near De Beque, Colorado.

G. F. Williamson has resigned from the position of superintendent of the Blue Mountain gold mine in Kern county, California, and is now at Amador City.

F. C. Calkins, geologist of the U. S. Geological Survey, is in the Big Cottonwood mining district, Utah, completing a survey that was started some years ago.

George S. Rice, of the U. S. Bureau of Mines, passed through San Francisco on his way to Alaska, where he will make a study of the Matanuska coalfield.

Roy H. Elliott was staying at the Ohio House, at Placerville, when it was burned on June 26, and narrowly escaped, suffering some burns, fortunately not serious.

R. C. Gemmell has been elected a director of the Nevada Consolidated Copper Co., and **Louis S. Cates** a director of the Utah Copper Co., these engineers respectively replacing **William Potter**, who has resigned.

Obituary

Arthur Kinney Adams died on November 2, 1920. He was born in Worcester, Massachusetts, on July 9, 1883, and attended the four-year course in general science at the English High School there from 1896 to 1900. He then spent three years at the Worcester Polytechnic Institute, from 1900 to 1903, combining the chemical and mechanical engineering courses. In the autumn of 1903 he entered Lawrence Scientific School, where he specialized in geology, receiving the degree of B. S. in 1904. The summer of 1904 was spent at the Harvard Engineering Camp, in field work in surveying. That autumn he returned to Harvard University, to the Graduate School of Arts and Sciences, studying advanced geology, especially applied geology, and acting as laboratory and field assistant in geology. There he received the degree of A.M. in 1905. In June of 1905 he was appointed field assistant in the U. S. Geological Survey, and spent the summer in topographic and geologic mapping of a coal- and oil-field in north-west Pennsylvania. Between 1905 and 1906 he spent half a year in studying mining, milling, and economic geology at the Massachusetts Institute of Technology while he was acting as laboratory and field assistant in mineralogy, lithology, field geology, and advanced field geology. In 1906, again as field assistant for the Geological Survey, he did further topographic and geologic mapping in Oregon and Colorado, later returning East to travel from Maryland to Alabama sampling and inspecting bituminous coal and mines in the Appalachian mountains. From 1907 to 1909 he taught in the New Mexico School of Mines at Socorro, New Mexico, as professor of geology and mineralogy. From 1909 to 1912 he was again in the government service, this time in the U. S. General Land Office as Mineral Land Inspector. As geologist and assistant mining engineer for the Socorro Mining & Milling Co., of Mogollon, New Mexico, he spent the better part of 1912-'13. He worked during the summer of 1914 in the smelter at El Paso, Texas. Further teaching followed in 1914-'15 at the Texas School of Mines, Fort Bliss, Texas, where he was professor of geology and coal mining. Between 1915 and 1916 he studied mining and milling methods in the South-West, especially with regard to the flotation of copper, silver-lead, and zinc ores. In 1916 he left for foreign work, entering the employ of the Andes Copper Mining Co. After eighteen months in Chile he returned to enter the U. S. Army. In July of 1918 he received a commission as 1st Lieutenant of Engineers, U. S. A.; and in August entered the Engineer Officers Training School at Camp A. A. Humphreys, Virginia. In October, after only two months as a student officer, he was appointed 1st Lieutenant in the Second Engineer Training Regiment. Two weeks previous to his discharge from the Army, in April 1919, he was appointed Instructor in Mineralogy and Senior Instructor in Geology at the Engineer School at Camp Humphreys. After his discharge from the Army, on May 1, 1919, he sailed from New York for a trip to Bolivia as geological engineer for the Guggenheim Brothers. In January 1920 he entered the employ of the Sinclair Consolidated Oil Corporation of New York. In February he proceeded to San José, Costa Rica, in charge of surveying the boundry line of a concession granted them by the Costa Rican government. His health was already affected as a result of work at an altitude in Bolivia. In July he contracted malaria; late in October he suffered a second attack, which occurred after he had returned from the field to his home in San José, where he died. He was twice married—in December 1909 to Helen Terry, of Socorro, New Mexico, whose death occurred five years later in El Paso, Texas; and in December 1919 to Dorothy Cobb, of Falls Church, Virginia.

THE METAL MARKET

METAL PRICES

San Francisco, July 5

Aluminum-dust, cents per pound	75
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.00—13.25
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$75
Platinum, 10% iridium, per ounce	$95
Quicksilver, per flask of 75 lb	$48
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

July 4.—Copper is inactive and soft. Lead is quiet but firm. Zinc is dull, but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighth of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
June 28	59.00	35.13
" 29	59.50	35.63
" 30	59.00	35.38
July 1	58.50	35.25
" 2	58.50	35.25
" 3 Sunday		
" 4 Holiday		

Average week ending	Cents	Pence
May 23	58.93	33.46
" 30	58.15	33.60
June 6	57.68	33.75
" 13	58.39	35.29
" 20	58.77	35 18
" 27	58.69	35.25
July 4	58.90	35.33

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	59.55
Mch.	101.12	125.70	56.08
Apr.	101.12	119.56	59 33
May	107.23	102.69	59.90
June	110.50	90.84	58.51
July	106.36	92.04	....
Aug.	111.35	96.23	....
Sept.	113.92	93.66	....
Oct.	119.10	83.48	....
Nov.	127.57	77.73	....
Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
June 28	12.62
" 29	12.62
" 30	12.62
July 1	12.62
" 2	12.62
" 3 Sunday	
" 4 Holiday	

Average week ending	
May 23	12.89
" 30	13.25
June 6	13.08
" 13	12.91
" 20	12.85
" 27	12.68
July 4	12.62

Monthly averages

	1919	1920	1921
Jan.	20.43	19.25	12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	12.74
June	17.53	19.00	12.83
July	20.82	19.00	....
Aug.	22.51	19.00	....
Sept.	22.10	18.75	....
Oct.	21.66	16.53	....
Nov.	20.45	14.63	....
Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
June 28	4.40
" 29	4.40
" 30	4.45
July 1	4.45
" 2	4.45
" 3 Sunday	
" 4 Holiday	

Average week ending	
May 23	5.10
" 30	5.02
June 6	4.90
" 13	4.75
" 20	4.47
" 27	4.32
July 4	4.43

Monthly averages

	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.78	4.32
May	5.04	8.55	5.01
June	5.32	8.43	4.57
July	5.53	8.63	....
Aug.	5.78	9.03	....
Sept.	6.02	8.08	....
Oct.	6.40	7.28	....
Nov.	6.76	6.37	....
Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	30.36
May	72.50	54.99	32.50
June	71.83	48.33	29.39
July	70.11	49.29	....
Aug.	62.20	47.60	....
Sept.	55.79	44.43	....
Oct.	54.82	40.47	....
Nov.	54.17	36.97	....
Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date	
June 28	4.75
" 29	4.75
" 30	4.75
July 1	4.75
" 2	4.75
" 3 Sunday	
" 4 Holiday	

Average week ending	
May 23	5.35
" 30	5.25
June 6	5.17
" 13	4.98
" 20	4.95
" 27	4.88
July 4	4.75

Monthly averages

	1919	1920	1921
Jan.	7.44	9.56	5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	6.49	8.76	5.33
May	6.43	8.07	5.37
June	6.91	7.92	4.96
July	7.78	8.18	....
Aug.	7.81	8.31	....
Sept.	7.57	7.84	....
Oct.	7.82	7.50	....
Nov.	8.12	6.78	....
Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
June 7	50.00
" 14	50.00
" 21	50.00
" 28	48.00
July 5	48.00

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	50.00
June	94.40	85.00	49.50
July	100.00	88.00	....
Aug.	103.00	85.00	....
Sept.	102.60	75.00	....
Oct.	86.00	71.00	....
Nov.	78.00	56.00	....
Dec.	95.00	52.50	....

STATISTICS ON GOLD

Gold imports into the United States in the fiscal year just ended aggregate, in round terms, $650,000,000, or more than in any year except 1917, when they aggregated $977,000,000, says a statement by the National City Bank. Of course, adds the bank's statement, not all of the $2,630,000,000 of gold imported since the beginning of the War has remained with us, for the gold exports in the same period (1914-1921) aggregated $1,435,000,000 leaving the net imports (in excess of exports) for the entire period of 1914-1921 $1,190,000,000, while the $530,000,000 turned out by our mines during that period brings the total additions to our gold stock since 1914, by importation and domestic production, up to $1,725,000,000, of which, however, nearly $300,000,000 has been used for industrial and scientific purposes, leaving the net additions, since 1914, to our gold available for currency purposes about $1,350,000,000. It is not surprising then that the Circulation Statement of the Treasury Department shows the total stock of gold in the United States on June 1, 1921, as $3,175,000,000, against $1,892,000,000 at the beginning of the War.

What has the remainder of the world done about gold for monetary purposes meantime? The Reports of the Director of the Mint showing the "approximate stocks of money in the principal countries of the world" put the total of gold for all countries for which statistics were available at $8,240,000,000 at the beginning of 1914 and $8,340,000,000 at the beginning of 1919, though the 1919 tabulation fails to include figures for certain countries which are known to have been at that time about $500,000,000, suggesting that the total of world's gold stock at the present time is nearly $9,000,000,000, though only a small proportion of this is in actual circulation, most of it being held in banks and public treasuries as a basis for the enormous paper circulation.

This world total of approximately $9,000,000,000 of gold stock available for currency seems to add weight to the often expressed belief that only about one-half of the world's gold production passes into coin or becomes a basis for currency, since the known figures of gold production from the discovery of America to the present time show a grand aggregate of $18,000,000,000, of which total about one-half is now recorded as in existence, either in the form of coin or as a basis for circulation. Curiously, too, about one-half of this enormous total of $18,000,000,000 produced by the mines of the world has been turned out since the famous gold versus silver campaign of 1896, since the records of world gold production show the total outturn from 1896 to 1921 at $9,335,000,000 out of a grand total of $18,115,000,000 from 1492 to 1921.

The share of the United States in the existing gold 'monetary stock' of the world has advanced from about 22% prior to the War to approximately 37% at the present time, though this figure as to present conditions can only be a rough approximation owing to the difficulties of obtaining late figures for certain countries under the now existing conditions.

MONEY AND EXCHANGE

Foreign quotations on July 5 are as follows:

Sterling, dollars:	Cable	3.74½
	Demand	3.73½
Francs, cents:	Cable	8.11
	Demand	8.09
Lire, cents:	Demand	4.95
Marks, cents		1.39

Eastern Metal Market

New York, June 29.

The approaching holidays incident to Independence Day, together with the usual summer dullness, has intensified, if any thing, the prevailing inactivity of all markets.

Copper buying is reported as being fair by some and absent by others, with prices easier.

Buying of tin is moderate and spasmodic with prices steady.

The lead market is quiet and easier.

There is a little more activity in the zinc market at lower prices.

Antimony has again declined.

IRON AND STEEL

Reports have persisted that announcements of fresh reductions in steel prices would be made on July 1 by the Steel Corporation, but there are no indications of such a formal step, says 'The Iron Age'. Actual market developments further confirm what was in evidence last week that both the Steel Corporation and leading independent makers are meeting competition as it appears. This process is causing a gradual settling of prices.

The most encouraging indications are the activity of the administration at Washington in hastening the payment of the Government's debts to the railroads; the prospect that railroad bonds will be accepted by the Government on its counter-claims; and the placing of a fair amount of steel for the repair of cars, with the prospect that considerably more will follow shortly.

The scale of mill operations is little changed, being from 15 to 25% for a number of independent companies and about 30% for the Steel Corporation. There is agreement in the expression coming from several steel-making centres that the falling away in demand is entirely without parallel and that the extent of unemployment is greater than leaders in the trade had believed possible.

The iron and steel duties in the new tariff bill are a surprise to the trade in their close approach to the then fully protective schedules of the Payne-Aldrich Act of 1909.

COPPER

Opinions of the market vary, some sellers reporting a fair business each day for both foreign and domestic account and others asserting that there is practically no demand. Those sellers who refuse to quote less than 13 to 13.25c. for early or July delivery are the most pessimistic, while those who are willing to meet the market reasonably are more optimistic and are selling copper almost daily. For instance one seller sold recently about 100,000 lb. on one day and 150,000 lb. on another with quotations reported on 400,000 to 500,000 lb. on another day which were reasonably sure to result in sales. In such circumstances sellers have done a fair business about equally divided between foreign and domestic buyers and they predict that for June their sales will amount to a fair total, though not as large as in May. While sales of small lots of electrolytic copper have been made as low as 12.50c., New York, the great bulk of the July metal has gone at 12.87½c., delivered, or about 12.62½c., New York, which we quote as the market, these being the prevailing prices for present day business. Lake copper is largely nominal at about the same levels as the electrolytic market, or 12.87½c., delivered.

TIN

Prices of spot Straits tin have been steady to firm all the week, remaining close to 29c., New York, which was the quotation yesterday. On most days the market has been quiet and inactive, excepting one day the middle of last week when sales, estimated to total from 300 to 500 tons, were made. These were largely purchases by dealers with some consumers sharing interest. Aside from this one day, the market has been almost stagnant. London prices have also been steady with quotations yesterday at £166 10s. for spot standard, at £169 for future standard, and at £167 10s. for spot Straits, all about £2 per ton above the prices a week ago. Arrivals thus far this month have been 1540 tons with 2000 tons reported afloat.

LEAD

The market is generally quiet and devoid of much interest. The only feature has been the reduction late last Wednesday by the leading interest of its price from $4.50c. to 4.40c., both New York and St. Louis. In the outside market prices have been lower with sales made down to 4.25 to 4.30c., New York, during the last few days of last week, but there was not a broad market. Yesterday the market was fairly stable at 4.40c., New York, or 4.15c., St. Louis, with some sellers quoting the latter base at 4.25c. Statistically this market is the soundest of all.

ZINC

A little more interest is reported but it is small. The market has been stagnant so long that even a flutter of buying is almost sensational. However, some producers at least are more willing to meet the market, due perhaps to low ore-prices and a probable readjustment in labor. During the week values have declined quite sharply so that prime Western is quoted and has sold at 4.25c., St. Louis, or 4.75c., New York, for wholesale lots for early delivery. The market is not active but is showing a little more life than in many weeks and the bottom is believed to have been about reached. Importations have been very heavy in recent months, due to the desire probably to forestall any increase in duty. These stocks have, therefore, depressed the market all this time.

ANTIMONY

Prices are lower with wholesale lots for early or July delivery quoted at 4.87½c., New York, duty paid, with jobbing lots from ¼ to ½c. higher.

ALUMINUM

There has been no change in the reported quotations of the leading interest of 28c. f.o.b. plant, for wholesale lots of virgin metal for early delivery. For foreign metal of the same grade prices vary according to the seller and the source of the metal, or from 22 to 23.50c., New York.

ORES

Tungsten: The market continues exceedingly quiet with quotations largely nominal and unchanged from those prevailing a week ago. This is also true of ferro-tungsten.

Molybdenum: No interest in the market is reported with quotations nominally unchanged at 50c. per pound of MoS_2 in regular concentrate.

Manganese: There is absolutely no demand. While the quotation is 22.50c. per unit, seaboard, for high-grade foreign ore, it could be possible without doubt to shade this on a firm offer.

Manganese-Iron Alloys: The markets for both ferro-manganese and spiegeleisen continues featureless and inactive. A carload lot of spiegeleisen is reported to have been sold. The quotation for the 20% grade is $30, furnace, as a minimum. On an inquiry for 100 net tons of ferro-manganese for the Government, bids made public reveal prices down to an equivalent of $72.80, delivered, for the British alloy, equivalent to about $70, seaboard. This compares with $75 recently asked. Domestic alloy is still quoted at $80, delivered, but could be bought at less.

INDUSTRIAL PROGRESS

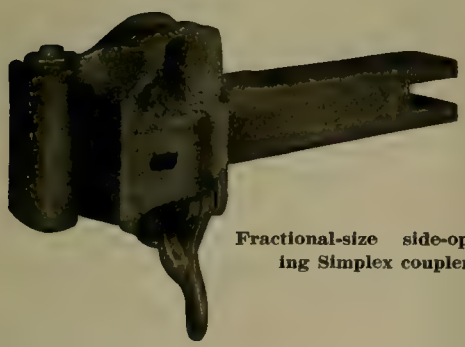
INFORMATION FURNISHED BY MANUFACTURERS

FRACTIONAL-SIZE AUTOMATIC COUPLERS FOR MINE AND INDUSTRIAL CARS

The design of fractional-size automatic couplers manufactured by the American Steel Foundries of Chicago are identical with those of the full-size standard railway couplers manufactured by this company.

All of the operating features of the full-size couplers are incorporated in these smaller ones, so that they may be operated entirely by means of an operating lever at the side

Fractional-size bottom-operating Alliance coupler



Fractional-size side-operating Simplex coupler

of the car, doing away with the necessity for the operator going between the cars to make or break a coupling. It is this safety feature and the great saving in operating time which has made the automatic coupler such a success on the railroads of the United States.

The operating features of the American Steel Foundries fractional-size couplers consist of a positive arrangement to throw the knuckle open preparatory to coupling; automatic locking of the knuckle when cars are moved together; an anti-creep device on the lock to prevent its creeping up and permitting accidental unlocking; and a lock-set whereby the lock when raised rests in a position above the knuckle-tail to permit knuckle opening freely when uncoupling. This feature does away with the inconvenience and dangerous practice of a man running beside the car and holding up the locking-pin until the cars have parted in making a running-shift. It is also a great convenience when making a cut in a standing train to be able to set the lock and then give the signal from any point at a distance from where the cut is to be made. The automatic coupler is always ready to make a coupling; there are no loose links or pins to be lost or misplaced.

The material used in the small couplers is the same as used in the standard couplers, and consists of high-grade open-hearth cast-steel for the coupler body and all other parts that are not dropped forgings.

Fractional-size couplers are made in two designs: the Simplex and the Alliance. The former is the same design as the well-known standard Simplex coupler, of which there are over a million and a half in use. They are noted for their strength, simplicity, and positive coupling action.

The half-size Simplex coupler is furnished in the top-operating type only and is adapted for use on narrow-gauge cars up to 10-tons capacity, such as mine-cars, tunnel-cars, dump-cars, etc. Both lock and lifter are dropped-forged. The standard design weighs 47 pounds.

The three-quarter size Simplex coupler is furnished in the top-, side-, and radially-operated designs, the latter two being recommended where there is danger of the uncoupling rigging being bent from projecting loads. These couplers are suitable for use on narrow-gauge cars of from 10 to 20 tons capacity or on standard-gauge cars such as open-hearth charging-box cars, dump-cars, etc., where it is not desired to use full-size couplers. Standard couplers weigh 124 pounds.

The Alliance coupler represents the latest development in couplers, embodying all of the improvements which have been found desirable to meet the present-day demand of traffic. These improvements are just as valuable in the fractional-size as in the full-size coupling. They consist mainly of interlocking lugs, or pin protectors on the hub or knuckle, and pulling lugs on the tail of the knuckle which interlock with corresponding lugs in the head of the bar. Both of these features add greatly to the strength of the coupler, and by relieving the pivot-pin of the greater part of all strains, prevent wear and consequent loosening, thus greatly increasing the service life of the coupler.

The Alliance half-size coupler is made in top-, bottom-, and side-operating design suitable for narrow-gauge cars of 12-tons capacity, such as mine-cars, tunnel-cars, dump-cars, etc. The weight of the standard design is 57 lb. This is about 20% heavier than the Simplex half-size, but the increase in strength over the Simplex is about 80%.

The three-quarter size Alliance coupler is furnished in top-, bottom-, side-, and radial-operating designs, and is suitable for application to narrow-gauge cars of from 12 to 25 tons capacity, such as mine-cars, dump-cars, etc., where it is not desired to couple with the standard full-size coupler. The weight of the standard design is 145 pounds.

In addition to the standard styles of shanks, all of these couplers can be furnished with any design of shank desired to meet any special requirements. Some of the special applications are couplers to fit in the link-slot on cars formerly equipped with link and pin; round-shank couplers for use on mine-cars, to allow one car to be turned over completely and dumped while remaining coupled in train; and numerous designs of long-shank, off-set shank, and pivoted heads, for electric, steam, and gasoline locomotives.

Where it is desired to handle cars such as charging-box cars with a locomotive that also handles standard cars, the fractional-size coupler is placed beneath a standard coupler.

DRILL-STEEL FROM HOLLOW INGOTS

*Hollow drill-steel is made by various methods: (1) The drilled billet with a sand-filled core, the general method used in this country. (2) The drilled, pierced, or the drilled and pierced billet, not sand-filled, is rolled down over a projecting ball much the same as in ordinary pipe manufacture. System (2) is employed largely in Sweden. In Sheffield, England, the general scheme is sand-filling. Swedish hollow drill-steel is particularly good and has a world-wide reputation for excellency. It does not follow, however, that steels made by other methods are not efficient, because they are.

The method employed by the Ludlum Steel Co. in the manufacture of hollow drill-steel is to insert a high-grade low-carbon mild-steel tube, suitably cleaned by sand-blast, into an ingot mold and cast the hot metal around the tube. We fill up the tube with some air-excluding material so as to prevent oxidation and scaling of the inside of the tube, generally using a high-grade sand for this purpose. The ingots are then rolled in the usual way down to the finished bar. The bars are cut to required length and the sand extracted by a special method, which is very speedy and extremely effective.

The tube method of making hollow ingots for the manufacture of hollow drill-steel is a decided departure from the old methods, and the logic of it seems to show that the resultant hollow drill-steel should be superior to that made by the older method. Tests made by the Ludlum Steel Co. to date show that such is the case; whether or not our premises are accurate, we believe that hollow drill-steel made this way will withstand alternating stresses better than anything that has yet been produced of similar analysis. The reasons why we believe the tube method of hollow drill-steel manufacture is superior to the older methods are:

1. Greater freedom from external and internal straining.
2. Because of the inherent small crystal size.
3. Absence of harmful segregations resulting in weakness of the wall of the hole.
4. Less liability for the steel to crack in the inside of the hole during forging or hardening.
5. Toughening effect, arising from the mild-steel wall of the hole, limiting the intense hardening on quenching.

ALLIS-CHALMERS ENGINE-TYPE ALTERNATORS

With the rapidly increasing use of gas- and oil-engines, particularly for units of larger size, and with the continued demand for electric generators driven by reciprocating steam-engines, the 'Engine-Type Alternator' finds many applications in modern central stations, municipal plants, and industrial establishments. This type of generator, used with any of these prime-movers, provides a compact generating unit, which on account of its convenient arrangement, requires a minimum of attention.

Allis-Chalmers alternators are of the revolving-field type, as this construction has proved superior to all others in both mechanical features and electrical performance. The armature-coils are stationary, and hence are not subject to mechanical vibrations or centrifugal force. They can, therefore, be readily insulated for high voltage and, as modern machines are frequently wound for high pressure, anything that contributes to perfect insulation is an important advantage. Moreover, with the stationary armature construction the collector-rings are not subjected to high pressure. The revolving field is excited by current supplied at low pressure so that the collector-rings are easily insulated and involve no undesirable features. Following the usual practice for engine-type generators, Allis-Chalmers alternators of this type are arranged so that the revolving field or rotor is mounted directly on the engine-shaft. These generators, designated as Type "AI", are therefore regularly furnished without base or bearings, the engine-bearings being used to carry the rotor as well as engine fly-wheel, while the stator is mounted either on the engine bed-plate or directly on the foundations.

Allis-Chalmers engine-type alternators are regularly listed in all sizes up to 1875 kva. for several types of prime-movers, and for the usual requirements of engine-speeds. Machines of larger size or for special requirements can be furnished to meet particular service conditions.

*Abstract of a paper by P. A. E. Armstrong at February 1921 meeting of the A. I. M. & M. E.

COMMERCIAL PARAGRAPHS

The Dayton-Dowd Co., of Quincy, Illinois, has opened a new district-office, for the sale of pumping machinery, in the Pioneer building, St. Paul, in charge of the George M. Kenyon Co., a firm of engineers of long standing in St. Paul.

The Pawling & Harnischfeger Co., of Milwaukee, has issued Bulletin 6-X, describing the P & H excavator-crane No. 206. The crane moves anywhere on its 'corduroys' designed to give traction on any service, and operates economically by gasoline power. Easily interchanged buckets and devices fit it for a variety of uses. Equipped with a crane-hook, it can be used for handling machinery, laying pipe, and similar work; a lifting-magnet may be attached if desired. With a clam-shell bucket the machine can be used to handle ore, stone, sand, coal, and similar material. An orange-peel bucket serves for dredging and a shovel-attachment can be conveniently utilized for any work where a revolving shovel is required.

In order to handle more satisfactorily its growing de-tinning business in the West, the **Metal & Thermit Corporation** has constructed and will shortly place in operation in South San Francisco a large new plant for the production of de-tinned billets, in addition to the de-tinning plants already operated by this company for several years at Chrome, New Jersey, and East Chicago. The new South San Francisco plant has been equipped with a large welding-shop containing excellent equipment and facilities for undertaking repairing by the Thermit process. With this new equipment at its disposal the company is exceptionally well prepared to render prompt and efficient service to its Western customers The new plant will be in charge of Em. Kardos. The cost of the plant is estimated in the neighborhood of $800,000. The former offices of the company, situated at 329-333 Folsom St., San Francisco, have been moved to the new plant.

The Link-Belt Co. has acquired all of the capital stock of the **H. W. Caldwell & Son Co.**, and Frank C. Caldwell has been elected a director of the Link-Belt Co. Two experienced and successful companies in the conveyor-machinery world have thus joined forces, with the result that the Link-Belt Co. has added two new lines, 'Helicoid' conveyors and power-transmission machinery, to its line of manufactures. While the H. W. Caldwell plant will continue to operate under separate corporate existence and under its present name, the joint facilities of the two companies, and the broader avenues of distribution of the Link-Belt Co. ought to prove of distinct advantage to the customers of both. There will be no modification of the policies of the Caldwell plant, no impairment of its service to its customers, no change in the diversity or character of its product. The plant-management will remain substantially the same, and the new owners, like the old, will proceed on the theory that the goodwill of its customers is the company's best asset.

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T. A. RICKARD, - - - - Editor

FLOTATION of a mixed copper ore at Mount Lyell, in Tasmania, is described by Mr. L. V. Waterhouse in a detailed article appearing in this issue. Several interesting devices will be noted. It is curious that eucalyptus oil is still being used, in admixture with coal-tar. At one time the kind of oil used in a flotation mill varied with the geography; thus pine-oil in the United States, eucalyptus oil in Australia, and camphor oil in Korea.

DIVIDENDS to be paid to stockholders of some of the gold-mining companies of the Witwatersrand indicate a healthy return on the basis of the original investment. On June 30, the New Modderfontein Gold Mining Company set aside, for early payment, an amount equivalent to 42% of its original share-value; the Modderfontein B. Gold Mines company, 40%; the Rand Mines company, 35%; the City Deep company, 20%; and the Crown Mines company, 10%. Unfortunately the public purchased most of these stocks at a big premium, but the returns indicate a handsome profit on the real investment by the original shareholders, if they still retain their stock.

PROSPECTS of a resumption of mining in Siberia seem to be brighter by reason of the negotiations in London between the representative of the Soviet government, the British Board of Trade, and the officials of the Russo-Asiatic Consolidated Company. This company has mines and smelters in the Altai district and on the Irtish river. It is an English company, but it has employed, and is still employing, several well-known American mining engineers, notably Mr. J. Power Hutchins. The Board of Trade has signified its approval of the agreement whereby the Soviet Government returns the Russo-Asiatic concessions to that company and permits a resumption of work. It is stated, in the 'Financial Times' of London, that the company, a large affair, capitalized at £12,000,000, has an organization and equipment that will enable it "very soon to produce supplies of gold, copper, lead, zinc, etc., all so much needed by Russia". It is conceded that the company shall have "the right to allocate a substantial proportion of its profits for the payment of an adequate dividend to shareholders, that a further proportion shall be laid aside as reserves for future requirements, and that only on the surplus shall the Soviet Government levy taxation, say, to the extent of a quarter". Of course, adjectives like 'adequate' and 'substantial' leave scope for interpretation, but the agreement is an interesting example of a compromise between the forces of sentimental anarchy and those of industrial capitalism. The Soviet Government, moreover, we are informed, "is prepared to lend all assistance possible to the concessionaires in the way of facilitating the supply of labor and transport". This sounds delightful, but, as we are nearer to Missouri than our friends in London, we have our doubts and even our suspicions regarding both the ability and good faith of Messrs. Lenin, Trotzky, *et al.*

IN this issue we publish an article that discusses the principal factors bearing upon the establishment of an iron and steel industry on this Coast. We heard the article delivered as an address by the author, Mr. Clyde E. Williams, on the occasion of the last meeting of the International Mining Convention at Portland. It seemed to us to contain much useful and interesting information and we hope that it may elicit further discussion from those who have investigated the subject. Obviously, the Pacific Coast will not achieve industrial independence until it produces its own iron and steel. We feel certain that it will; the question is, when? We hope that Mr. Nicol Thompson, of Vancouver, Mr. B. L. Thane, of San Francisco, and others will state their views for publication in our pages. We take the opportunity of adding that the work done by Mr. Williams marks the useful co-operation of the College of Mines, in Washington University, at Seattle, with the Northwest Experiment Station of the U. S. Bureau of Mines.

FROM the Kansas State Agricultural College comes a true word. Mr. H. W. Davis, the director of that useful institution, asserts that "newspapers and magazines control the language in this country". He told the National Education Association, in convention assembled, that a newspaper 'story' that carries its message 'across' has done its duty; in short, that good English is effective English. We agree that the development of our language is largely in the hands of those who use it most —the newspapers and periodical press; and that is why we deplore the fact that they indulge in so much sloppy writing, because they are undoing the work of the schools and universities, where our youth of both sexes is taught,

among other things, how to use the language correctly. Where we disagree with Mr. Davis is in his supposition that the English of the newspaper story is usually effective; it seems to us, from daily experience, that much of the reportorial work is ineffective because it is written carelessly and ignorantly, by those who prefer the language of the gutter to that of the library.

DISCUSSION this week is again enriched by several notable contributions. The first is from Mr. E. M. Hamilton, who writes on a subject in which he has won recognized place as a specialist, apart from the fact that he ranks among the most scholarly and conscientious of our technical writers. A soldier, Mr. Waldo Lee Clark, asks that special consideration be shown, in the matter of assessment work, to those who were disabled in the War; and his plea will meet with sympathy. A prospector, Mr. A. G. Dingle, complains that he cannot get anybody to inspect his mineral discovery, but we feel certain that he could get friendly treatment in the matter of an ore-test, if he made the acquaintance of those at the School of Mines of his own State. Mr. L. C. Denny recognizes the honest intellectual effort that has been made to improve the mining law, but, like others. he demurs to the requirement that the claim-lines must be run so as to conform with the existing subdivisions of the General Land Survey. This protest is seconded by Mr. Frank P. Davis, who likewise anticipates that the rigid enforcement of such a regulation will prove a hardship to many prospectors and be impracticable without a systematic survey in localities where the Land Survey is incomplete. He is unfair, we think, to the mining engineer, in supposing that the members of our profession mean to euchre the genuine prospector; the regulations, of course, are meant to simplify and to assist the location of mining claims in the interest of the legitimate prospector; they should be discussed from that point of view, and corrected if they do not further their implicit purpose. The last contribution to 'Discussion' is a long, and interesting, one, from our correspondent in Mexico, Mr. Robert B. Brinsmade.

TROUBLE has arisen at Hornsilver, 28 miles south of Tonopah, in Nevada, over the interpretation of the Statute regarding the performance of assessment work on unpatented mining claims. The issue raised is this: must the prescribed amount of work be completed on the last day specified, or may the work continue until completed, providing a start was made before the expiration of the period provided by law. The particular claims involved comprise the property of the Southwestern Mines Company, for which Mr. S. H. Brady is receiver. Two of the 11 claims are of particular value because they adjoin, on the strike of the vein, the Orleans claims from which Mr. J. W. Dunfee is mining rich ore. A small mill is situated on the property. It seems that Mr. Brady arranged a lease with Mr. Tim Connolly, with the expectation that his labor would satisfy the requirement of the law as to assessment work. The lessee, however, deserted the claim, presumably without at once notifying Mr. Brady; when he finally learned of Mr. Connolly's departure, the receiver sent to the property a party of miners who started work at 8 p.m. on the night of June 30. On the morning of July 1, twelve men, one of whom was Mr. William Cavanaugh, the original locator of some of the claims, posted new notices of location for each of the 11 claims. They are said to be ready to go to court to obtain title to the property. However, we venture to predict that further legal advice will dissuade them from starting any litigation. The courts have repeatedly held that if a man start work prior to the expiration of the year, and continue it with reasonable diligence and without interruption until the prescribed amount has been performed, any adverse claimant is in the position of a trespasser. The Act of Congress approved by the President on December 21, 1920, whereby the final date for the work of 1920 was deferred until June 30, 1921, obviously is special legislation, but it seems improbable that any court would deviate from the established precedent on that account.

SUCCESSFUL industrial operations abroad depend, in no small measure, on confidence in the stability of the government in power; without this confidence, capital looks elsewhere for investment opportunities. An autocratic and erratic president may plunge a country into chaos; a weak monarch can do no more. Conditions in Peru are being watched with some concern, although the national game of politics has been played so uninterruptedly of late years that the Peruvians themselves, as well as their neighbors, are past being surprised at what does or may occur. Mr. A. B. Leguia, the President, assumed office under circumstances that are reminiscent of the plots of a Gilbert & Sullivan opera. He was a candidate for President, and the elections were to be held in August 1919. Not willing to rely on the popular choice, he drove to the presidential palace in the early hours of July 4—choosing the date so that the sound of any promiscuous shooting would be attributed to the exuberance of the Americans resident in Lima—and seized the reins of Government, apparently without opposition. The military were annoyed at being disturbed at such an hour, but otherwise the revolution passed off in a manner typically Peruvian. Mr. Leguia assumed office without national protest. His friends were jubilant, for the majority of them trusted their favorite, and honestly thought that the revolution would be for the ultimate good of Peru. But they were soon disillusioned as to Mr. Leguia's intentions, as well as with regard to his fitness for the high office of Chief Executive. Many of them saw the handwriting on the wall, and beat a hasty retreat to Paris or to London. Recently the President has become arrogant. Needing money for the centennial celebrations that are to be held to commemorate the aniversary of the independence of the country, on July 28. he applied to the banks for a loan; but the financiers of Lima were not impressed, and they refused to lend. The President then retaliated by prohibiting them from en-

gaging in foreign business; and the money he needed was raised through the aid of British oil-operators in Peru. Three newspapers have been suppressed recently on account of their outspoken criticism of the President's autocratic actions; the university of San Marcos has been closed; and reports indicate that Mr. Leguia is succeeding in killing all opposition to himself and his tactics by banishing some of his political opponents to Australia, and by imprisoning the remainder on an island quarantine station near Callao. The administration has been regarded as a joke for many years, and this is one of the reasons why the country is rightly classed among the unprogressive States of South America. The people appear to take the antics of their political mountebanks as a matter of course; they are too tired to argue about, or to protest against, the conditions that seriously impede the development of Peru.

THAT the use of good English is a specialized study in university training, rather than an essential in every phase of the curriculum, is an objection that is voiced by an anonymous member of a faculty club, whose opinions appear in a recent issue of the 'Christian Science Monitor'. The standard of undergraduate English is on the decline. The poor composition of college men has been attributed to the newspapers; an educational diet that ignores Greek and Latin is said by others to be responsible; but it is clear that neither of these, in itself, can be the cause. The trouble, in the opinion of a professor of English, is because the entire question of verbal expression of thought is a matter that is confined to the English department of the university, which, it is clear, should not be obliged to shoulder the whole responsibility for instruction in written and oral expression of specialized branches of learning. The student, for instance, does not bring his biology into the class-room for inspection; but he does take his English, or a substitute for it, into the biological laboratory; the professor of biology incurs a responsibility in this connection; and if he realizes that knowledge and adequate expression cannot be divorced, he will not throw the entire responsibility upon the department of English. He will see that every man in the faculty must be, from time to time, a teacher of expression. At present it is natural for the freshman, when he leaves the English class-room, to cast aside all concern about commas or dangling participles; they are mere English, in his opinion, for which he hopes to get separate credit. In the history class he is concerned with facts; and so he writes and speaks as he pleases. It is this separation of expression from thought and knowledge that defeats all efforts to improve undergraduate English. The remedy, according to the professor, is co-operation; failure will result if all is left to the department of English; it is folly, he says, to expect that one course in the freshman year will uproot all the weeds of faulty speech, and will sow the seeds of excellent expression that will continue to blossom throughout the student's later life. Only steady and concerted effort on the part of the entire faculty can achieve such a result; students must be taught that true knowledge and clear expression are one and inseparable. Satisfactory speech and writing will result only when in every class-room—and whatever the subject being taught—accuracy, correctness, and even grace of expression are demanded of all students at all times in their written and in their oral work. We consider that there is much that is logical in this viewpoint. In too many cases the acquisition of an easy and correct style in the presentation of technical facts comes, if it comes at all, long after college days have passed.

Oil and Friction

Vehement denial, says a press dispatch, was made recently by Viscount Curzon that Great Britain seeks to control the world's undeveloped oilfields. This is one of the questions that are supposed to 'strain' friendly relations between the two English-speaking countries, and it is well to refer to it if by doing so that strain can be lessened or removed. Lord Curzon denied that the British government is "co-operating with British interests to secure an oil monopoly"; he said that such an idea was "entirely without foundation". We accept his statement, of course, because a man of his character and position does not say what is untrue. He acknowledged that "there were some restrictions" on exploitation for oil in British territory, but that was "during the War", and the restrictions "have now been removed". Lord Curzon stated that whereas Great Britain imported 3,368,600 tons of oil in 1920, her domestic production was only 166,000 tons. Of the oil imported, 61% came from America, 37% from other countries, and only 2% from the British possessions. Yet 90% of the British navy is now oil-fired, and the use of oil is increasing in the mercantile marine; so that the urgency of a supply of oil is manifest. Canada's oil exploitation is confined to companies of British register, but the chief of these is the Imperial Oil Company, a subsidiary of the Standard Oil Company. Various charges and counter-charges have been made in consequence of the rivalry in oil exploitation, of the British in Persia and Mesopotamia, and of Americans in Colombia and Mexico. Much of the newspaper talk is misinformed, if not malicious. For instance, the shipment of oil from Wyoming to a Canadian refinery owned by the Imperial company is instanced as a British depredation, whereas the Imperial company is controlled in the United States. Not long ago the same authority, Lord Curzon, who, we believe, is Secretary for the Colonies, denied the rumor that his Government was interested directly or indirectly in the Royal Dutch combine, although our Secretary of State, Mr. Hughes, thought it necessary to send a note to Holland demanding participation in the Djambi oilfield, which is owned exclusively by the Dutch. We believe in protecting our nationals in their mining enterprise abroad, whether in Mexico or in Persia, but, as the 'New York Journal of Commerce' said wisely not long ago, "We cannot be international where American foreign

trade is concerned and national where the foreign trade of other countries is at stake".

American enterprise is that of individuals and syndicates, it is in no way backed by our Government, whereas the British government during the War did take active steps to stimulate the production of oil within its own or protected territories, and that is why objection has been raised by some of our oil-operators, who demand a free field for their competition. The world needs the initiative of the Dohenys and Bedfords, just as it needs that of the Cowdrays and Deterdings. Our people control 80% of the oil production of the world, and we ought to be able to meet others in competition without getting hot about it. There is need for the enterprise of all in finding and producing the ever-increasing quantity of oil demanded by modern industry. Surely it makes no difference whether an American exploits oil in Burma or an Englishman in Wyoming, provided the oil in the one case goes to the English market and in the other to the American market, as assuredly it would in either case. The English-speaking peoples cannot afford to quarrel over such matters, when issues so much bigger are at stake. We have been comrades in arms recently in defence of our civilization; we have a common purpose in striving for world peace; our peoples desire intensely that general disarmament may be brought about by conference between our leaders and those of other nations; most of us are sick of the petty jealousies and mean recriminations that have followed the successful conclusion of our war with Germany and her dupes; is all the fine emotion to be lost in petty spites and commercial rivalries? Can we not recapture the vision of the heroic years but lately past, and once more rise above all meaner things to a plane of manly goodwill and friendly competition?

Evasion of Licensing

The problem of the licensing of engineers is beset with difficulties, because the passage of legislation may result in evasion, on the one hand, or it may inflict hardship, on the other. In the State of New York there is a law to provide for the licensing of professional engineers, but unfortunately it permits corporations and unrestricted partnerships to practise, irrespective of the conditions of this law. They are exempt. This particular State legislation was enacted in the face of strong opposition from the American Society of Civil Engineers, among others. The American Association of Engineers, founded to promote the economic and social welfare of the members of the profession, at its recent convention in Buffalo, adopted a resolution that indicates opposition to the enactment of laws for the licensing of engineers, which, at the same time, permit corporations, unrestricted partnerships, or joint-stock companies to practise in a similar capacity and without legal restraint. Such a law is discriminating; its enforcement nullifies the purpose of licensing by permitting groups of men who are not engineers, to do, indirectly it may be, those things that the individual who is not an engineer is prohibited from doing; it allows them to act in a professional capacity in the same manner as one whose technical training and moral qualifications have been subjected to a searching examination, and who is permitted to practise only after he has paid the prescribed fee. Such legislation sanctions a procedure that may become immoral, in permitting an aggregate of individuals, in whole or in part composed of men who are not engineers, to serve in the dual capacity of supposedly disinterested advisers to a client, and at the same time as self-interested financiers, sellers, or contractors in the execution and supervision of work in connection with which such advice is given. Such sanction is opposed to the sentiment that an engineer shall not be personally interested, directly or indirectly, in a company with which he has relations in behalf of his employee or client; it sanctions a condition under which an engineering corporation may have bankers, manufacturers, and contractors on its board, who may so dominate the policy as to influence the management, including its engineering employees, in the preparation of reports, plans, contracts, and specifications, and in the supervision of work, in such a manner as to favor the outside interests of such directors and to the injury of the public. Thus the professional engineer in the employ of an engineering corporation or unrestricted partnership, which is made up in whole or in part of persons who are not engineers, is relegated to a position of anonymity, and is relieved of all professional responsibility to the client; he is placed under the direction of those whose primary interests in the work may be in the making of a contractor's profit. Conditions are permitted under which a group, constituted in whole or in part of men who are not engineers, may violate, with impunity, the codes of ethics that have been adopted by various professional societies for the guidance of their members and for the protection of the public. Corporations are free to advertise in a blatant manner and to solicit patronage; professional engineers are restrained from so doing either by good taste or from a sense of professional etiquette. There have been instances in which engineering corporations have adopted methods that are in direct violation of the codes of professional ethics to which some of their officers or members in their individual capacities have subscribed. This, it is maintained, is unfair to the independent engineer, and is destructive of that respect for the profession which should be of public concern. The result is that engineers are forced to give up independent practice and are obliged to abandon purely professional work in order to affiliate themselves with contracting organizations, thus denying the public the disinterested and effective service of the men who, hitherto, have been chiefly responsible for progress in the art of engineering. We have given the Association's argument in full detail; the subject warrants this action. We suggest that the Mining & Metallurgical Society of America, which is now considering the question of licensing in all its aspects, should include in its researches a study of this phase of professional work.

Cyanide Regeneration During Precipitation

The Editor:

Sir—Regarding the question of cyanide regeneration during zinc precipitation raised by Mr. Del Mar, in your issue of June 11, I think that both in his article and in other writings on the same subject the point at issue is obscured by a failure to distinguish between free and total cyanide. The author of the article does not apparently recognize such a distinction, and yet it is an important one. By "free cyanide" is meant, of course, the simple uncombined cyanide salt in solution. The term "total cyanide" is more conventional, since such compounds as ferrocyanides and sulphocyanates are excluded: indeed as ordinarily used it does not even cover the gold, silver, and copper double cyanides, since the first two are not titrated in terms of cyanide by the ordinary silver nitrate method, and the copper only in part or not at all; so that for practical purposes the term "total cyanide" may be taken to mean the free or uncombined alkaline cyanide plus the double zinc cyanide, Na_2ZnCy_4. Now there is a distinction to be observed between these two compounds both (1) as to their determination in the solution and (2) as to their relative functions in the dissolving of the precious metals.

(1) The nearest approach to a correct determination of free cyanide by the silver-nitrate method is made by titrating to the first faint bluish-white cloudiness produced in an originally brilliantly clear solution, and needs to be observed carefully with the right incidence of light and against a dark background. The determination for total cyanide (understood as already explained) is made by adding potassium iodide indicator and titrating to the yellow opalescence characteristic of silver iodide. For the accurate determination of this compound it is usual to add caustic soda as well as KI to the solution to be tested, but if the free alkalinity (whether it be the result of lime or caustic soda) already present in the solution amounts to about 0.1%, in terms of NaOH, the reading obtained will be the same as if caustic soda be added; so that the common practice of adding KI indicator and titrating to the yellow end-point will give a reading that often represents the "total" cyanide or the free plus all the double zinc cyanide, and will nearly always give a reading in excess of that demanded by the free cyanide alone. The above distinction in titrating methods has to be modified somewhat in cases where a considerable amount of copper is present in the solutions, but for the purpose of the present discussion it may be allowed to stand.

(2) It may be asked, "Why trouble about any distinction in the titrations when the double zinc cyanide is as effective a dissolving agent as the single alkali-metal cyanide?" But is it? I maintain it is not. In the case of silver I made a long series of experiments some years ago on precipitated silver sulphide dried and pulverized, and found that a solution of Na_2ZnCy_4 had almost no dissolving action on it, such small action as there was being accounted for by the slight degree of dissociation of the double salt in solution, since a free cyanide titration made as already described indicated the presence of a small quantity of uncombined cyanide.

On gold, the action of the double zinc cyanide may be considered open to question. Julian and Smart state that their experiments showed that gold was soluble in K_2ZnCy_4, the ratio of efficiency being 96 as against 109 for simple KCy solution. This observation, however, is somewhat marred by the admission that the zinc solution was "probably" saturated with zinc, implying that the actual constitution of the solution was not determined. The same authors quote W. R. Feldtmann in support of the solvent action of the double zinc compound, but the quotation deals only with the effect on its dissolving power produced by addition of alkali, which is not the point at present under discussion and belongs to an entirely different category, since we are now dealing with the actual dissolving power of the double salt in its combined state and not with its potential dissolving power after having been partly or completely dissociated by addition of alkali or by other expedients. J. A. Sharwood (American Chemical Society, Vol. 25, p. 580) states that the solvent action on gold of solutions of potassium zinc cyanide is less than that of a solution of simple potassium cyanide containing the same amount, or one-half the amount, of cyanogen in equal volumes, and that it is increased by addition of caustic alkali. Gerard W. Williams (Journal Chem., Met. & Min. Soc. of S. A., Feb. 1904, p. 298) in summarizing the results of a long and careful investigation into the subject says that "although the 'free' cyanide increases proportionately with the alkali present, it is not practical to have all the cyanide in the double zinc cyanide in the 'free' state, owing to the secondary effects of an excess of alkali on the solutions. Hence the bulk of the K_2ZnCy_4 present is inert and useless for the purpose of solution of gold".

To return now to the article of Mr. Del Mar, it is easy in the light of what I have already said to conjecture what has given rise to the observation of an apparent

regeneration of cyanide during the act of zinc precipitation.

1. He states that KI indicator was used in the titration, and it may be assumed, therefore, that addition of silver nitrate was carried to the usual yellow opalesence. Under these conditions the reading obtained would indicate both the true free cyanide and a part or all of the double zinc cyanide also.

2. The ore dealt with was chiefly a silver ore and therefore the press-head solution would contain some double silver cyanide, which would not be recorded as cyanide in the titration.

3. In the press-tail solution the silver has been replaced by zinc and its associated cyanide is now recorded as such when titrated with KI indicator to the yellow end-point. Hence the reading obtained on the press tail is higher than that on the press head.

Had the titration in both cases been made to the first faint white cloudiness and not to the yellow iodide opalescence it would have been found that a considerable drop in the free cyanide content of the solution had occurred during its passage through the zinc-precipitation process. This I have found to be invariably the case, and it is quite in accordance with the accepted theories of the reactions that take place during precipitation. That this fall in free cyanide during precipitation does not necessarily imply the loss of the whole of cyanide apparently consumed I have always maintained, since a part of the inert double zinc salt is usually dissociated and rendered available (in other words, regenerated) when the solution comes in contact with fresh lime, as happens when it is pumped back to the mill or to a new charge of ore. Sulphides in the ore may also produce a further regeneration from the combined cyanide by formation of alkaline sulphides which would precipitate some of the combined zinc as sulphide with formation of simple alkaline cyanide.

It is thus evident that while some of the free cyanide consumed in dissolving the silver in an ore may later on be rendered available for further use through the indirect action of zinc precipitation, yet such regeneration does not take place in the act of precipitation but is a secondary result produced in the previously precipitated solution by contact with alkalies or other substances.

Regarding the three propositions that Mr. Del Mar offers for consideration at the end of his article, there is no doubt that the addition of lime (or caustic soda) to a zinc-press tail solution will regenerate free cyanide from the double zinc salt, and the increase may be observed by titrating to the true free cyanide end-point. As to the form assumed by the zinc as a result of the reaction, if the alkali added be caustic soda the zinc would no doubt remain in the solution as sodium zincate. If the alkali be lime there may be a formation of an insoluble zinc compound, either calcium zincate or, as Walter Virgoe supposes (Journal of Chem., Met. & Min. Soc. of S. A., August 1903), in presence of carbonic acid, a double carbonate of zinc and calcium.

$$K_2ZnCy_4 + 2Ca(OH)_2 + 2CO_2 = ZnCa(CO_3)_2 + 2KCy + CaCy_2 + 2H_2O$$

The expedient of adding sodium carbonate to the barren zinc solution I have never tried, but its first effect would, of course, be to precipitate the lime as carbonate with formation of caustic soda

$$Ca(OH)_2 + Na_2CO_3 = CaCO_3 + 2NaOH$$

The substitution of caustic soda for calcium hydroxide would no doubt prevent any precipitation of zinc, which would then remain in solution as sodium zincate.

San Francisco, June 25. E. M. Hamilton.

Assessment Work

The Editor:

Sir—I appreciate the position that you take on the question of assessment exemption. I feel that civilians should not be exempted but soldiers who were disabled in the service of their country and because of their disability should not be penalized by the Government failing to exempt them from assessment duty. The Committee of Mines and Mining, of the U. S. Senate, is considering it most seriously. It seems only fair to our disabled soldiers to exempt them from assessment duty as their condition physically cannot permit them to do their work, and their financial sacrifices during the War were such that they have no surplus now for the work. A paper like yours could help it out.

Tucson, Arizona, June 19. Waldo Lee Clark.

[We sympathize with this plea, naturally, and hope that some way may be found of putting it into effect at Washington.—Editor.]

Prospecting

The Editor:

Sir—I have been reading your articles on prospecting and your invitation for a discussion on its problems. It is good and timely that this should be done, for in our little city the buying on margin has brought disaster to many an individual; one I know has lost over $100,000 in the recent drop of standard stocks; others have lost homes, automobiles, and are down and out. They have not a dollar to finance mines at their very door. We have been working on mines for 15 years, two men working steadily the year around, and we cannot find even one who will go out and give them the look-over. What the average prospector needs most is ore-testing facilities by the State. I wrote to the head of our mining school, and he curtly informed me they could not tell what our ore contained but would look it over if we would send him some of it; our copper ore is complex like the Rossland ore; our gold-iron property needs a mill of some kind to be selected by an engineer. I think the porphyry will show good mill-values in depth. The silver vein is great; we shipped a test lot of ore to the Washoe smelter (now shut-down) last year and they charged $7.50 for smelting, $5 for sampling, and this, with the haulage charge, makes it unprofitable at 38 oz. per ton. What the

prospector needs most is some means to get in touch with capital that can help to patent and equip the property with air-drills, etc., as well as a mill to reduce the ore at its source. We bought 50 lb. of 60% 'powder' and it cost $18.50 at the store in town. The factory is at Ramsey, only eight miles from here. No wonder the Du Ponts can pay 1000% dividends. Big business is strictly against the prospector at every turn; while immense areas lie unprospected that are richer than aything yet developed. You will find a small circular enclosed, for all our treasury stock, 600,000 shares, is unsold and it is impossible to sell any stock in a concern that has the ore. Please excuse this long statement, but it is the story of the modern prospector.

A. G. DINGLE.

Anaconda, Montana, June 14.

[Our correspondent ought to send a sample, not a specimen, of his ore to the Montana School of Mines; we believe that he would obtain the information he appears most to need.—EDITOR.]

Revision of the Mining Law

The Editor:

Sir—A revision of the existing mining law is most vitally needed and the effort now being made seems to have all of the indications of being honestly and painstakingly undertaken, as is so well pointed out in your issue of June 18. Needless to say there has been a deplorable lack of uniformity in the laws of the various States and, even worse, there has been no general code that adequately covers the requirements in any new locality where local conditions compel a variance from the strict following of the statutes.

Alaska is a pitiful example of this. So much of the great wealth of the North was squandered in litigation that found its basis, primarily, in the unsuitability of the laws of the 'States' to the conditions there. In the formation of a new general code it would seem to me that no effort should be spared to provide for the protection of the prospectors and first locators in all new districts—especially districts outside of States already having more or less complete statutes covering their own peculiar problems.

Equally important with the provision for protecting locators and mine operators in new territory, and correlated to it closely, is the matter of laying out claims along lines conforming to subdivisions of the General Land Survey.

While such a law would have the valuable effect of appreciably lessening litigation through the elimination of fractional, blanket, and overlapping locations, it would put upon the prospector and locator an unjust burden in two ways. First, one always wishes to run his claim along the line of strike of the lode or the channel of a stream. It almost invariably happens that the course of a creek is the line which should be followed in making a placer location to permit the miner to realize his richest returns. Second, it is often most difficult to follow survey lines, and failure to do so under the newly proposed law would often mean loss of valuable ground and sometimes of development work. The outcome might be litigation not unlike what now often results from lack of regular boundary.

It is better to have fractions and over-lappings than for a prospector or operating company to lose the reward of discovery and pioneering of a district!

L. C. DENNY.

Fresno, California, June 28.

The Editor:

Sir—I have just seen the draft of the new revision of the mining law in your issue of June 18. Some parts are all right, but others not so. The conditions with regard to position of end and side lines, the date for the start of the calendar year, and, in cases where it is convenient, the location in legalized sections of the land survey, are all right. But I do make a big protest against rigid enforcement, as it is almost impossible for a prospector to comply unless he has a surveyor, with transit and a couple of rod-men, at his heels most of the time. Much of the public domain has not been surveyed, particularly in the mountains; maybe a line was run 40 years ago, correctly or by guess. I have been running lines for 40 years with a watch, a compass, or a Brunton, and it is difficult to find out where you are. Lots of corners that were put up have been taken away, buried, or destroyed by the big cow-men. The Government knows about it, but does nothing, as someone drawing Government pay is behind them. It is effectual in keeping the little homesteader out, as it would cost him two hundred dollars to find out if the land is owned or not. They also make it difficult for the prospector. A month ago I was prospecting where it would have cost me $250 to find out what county I was in. I have been where we could not tell which State we were in without incurring big expense.

In a year's time, after the Bill becomes law, we must get our claims surveyed and pay the recording fee; this would not be constitutional. We are satisfied with our present title, without incurring this extra expense. The land survey for claims and the making of a new title for claims, would be cause for much future legislation. This would give the engineers and surveyors permanent jobs, and the lawyers could cut in with their litigation. I am in favor of a law that would benefit them in any way, but not at our expense.

The mining engineer has very nearly killed prospecting since we lost the small promoter; and it looks as if he wanted to ball us up on the mining claims we are now holding. I wrote an article about the revision of the mining law in the 'Press' of June 13, 1914. There was much discussion; but what is the use? Any law that was made to help the prospector or small-mine owner would be jumped upon by the mining engineer. Why doesn't the Committee get a few well-known prospectors to tell them about their part of the game? The fundamental part of mining is the prospector's first location of a mining claim.

When the Utah legislature changed their laws in regard to mining 25 years ago they got two well-known prospectors to explain their views. The ideas were put into effect, and there was no kick from anyone, although the new laws were harder on the prospector than were the former ones.

FRANK P. DAVIS.

Fairview, New Mexico, June 23.

Taxation and the Mineral Industry

The Editor:

Sir—Since the first year of the War, we have had to pay four or five times as much taxation, annually, to the Federation as in former years. Like a new broom, the Republican Congress in session is now engaging in sweeping away the cobwebs of Democratic taxation in favor, perhaps, of a new set of cobwebs of its own. So I beg leave to elucidate a few of the general principles of taxation, disentangled, as far as may be, from the partisan webs that bind most of our periodicals, and many of our professional economists, when discussing this delicate question.

Practically, taxes can be obtained from five sources:

A. The consumer of merchandise.

B. The producer of merchandise.

C. The laborer.

D. Capital (cash, buildings, machinery, and other labor products).

E. Legal privileges and monopolies (land values, and patents or copyrights).

As regards their incidence, taxes may be classified as either 'direct' or 'indirect'. The first are levied directly on persons or property, the second on merchandise in transit from the producer to the consumer. To assure a system of taxation which shall be difficult to evade and which cannot be shifted from the first payer to others, in a disguised form, two Golden Rules of Taxation have been enunciated:

I. Tax only objects which cannot be hidden or spirited away.

II. Tax only objects which cannot be reproduced, for only then will the tax rest on the original tax-payer. Every tax on objects capable of being reproduced can be shifted, in the form of higher prices, to the consumer. Moreover, such taxes tend to discourage production.

In the following table I have arranged 15 tax classes with reference to their incidence, origin, and conformity with the Golden Rules:

No.	Name of tax	Incidence	Origins	Rule I	Rule II
I	Export	Indirect	B and A	No	No
II	Import	"	A and B	"	"
III	Merchandise-sales	"	A	"	"
IV	Land-sales	"	E	Yes	Yes
V	Real-estate-sales	"	E and D	"	"
VI	Poll	Direct	C, D, and E	No	No
VII	License	"	A and B	Yes	"
VIII	Land-value	"	E	"	Yes
IX	Unearned-increment	"	E	"	"
X	Real-estate	"	E and D	"	Partly
XI	Personal-property	"	D and E	No	No
XII	General-property	"	D and E	Partly	Partly
XIII	Income	"	C, D, and E	No	"
XIV	Excess-profit	"	E and C	"	"
XV	Inheritance	"	D and E	Yes	Yes

I. The Export Tax falls on producers, except in the special case where the exporting country sets the price for the commodity in the world market—as in the case of German potash or Mexican henequen—when the tax might be shifted to the consumer. The inhibition against an export tax in our Constitution is a needless handicap for the Government, in its control of exportation; for it leaves no middle ground between free trade and a complete embargo. By an export tax, a government can favor its domestic consumers at the expense of its own producers and to the detriment of the foreign consumer of the commodity. Thus an export tax on pig-copper would favor both our brass founders and consumers, and advantage the former in their competition with foreign founders, while our copper miners paid the piper.

II. The Import Tax has the opposite effect to the Export Tax, because it generally falls on the consumer. Only in an exceptional case (where the domestic market can be fully supplied by our producers at the world price of the commodity) would the foreign producer be obliged to pay the tax before he could enter our markets. These statements seem almost self-evident, and yet there is no economic subject that has been more obfuscated, in an effort to confuse the popular mind, than that of the tariff. Originally devised as a source of revenue at the expense of consumers of foreign merchandise, the Import Tax has had its greatest modern development as a means of 'protecting' domestic producers by raising the price of commodities in the home market.

Free competition, improved transportation, and new inventions tend to lower the cost of living, and are praised as beneficent, but often a tariff, designed for the special object of increasing prices, will be lauded to the skies. The dumping of foreign goods on our shores at trifling prices may seem a calamity for some producer, but I fail to understand why any consumer should object to getting the most for his money. As a temporary premium to aid the establishment of new industries, a protective tariff may be defensible; but even for this purpose it is far costlier than a direct bonus paid to the new producer, in proportion to his output, as was long ago discovered by progressive British colonies such as Canada.

But what of a system of *permanent* protection? At its best, it means the supporting of certain unprofitable industries at the expense of the rest, and is as sound commercially as would be the indefinite continuance of a hopelessly unprofitable mine by a company through subsidies paid from its dividend fund. At its worst, it means the plunder of domestic consumers by means of a monopoly formed by producers, who set their prices at the world price plus the tariff, irrespective of cost of production. This has been done in many instances, and in connection with the sale of borax, aluminum, iron, lead, soda, lime, and cement.[1]

III. The Merchandise-Sales Tax, when assessed nationally, must always fall on the consumer and will, therefore, like all indirect taxation, not only increase

[1] 'Protection and Free Trade', by Henry George, Chap. XI.

prices by the amount of the tax but also by an additional sum to represent the interest and profit on the capital advanced by the merchant to pay the tax. Hailed as a new discovery by our contemporary statesmen, this tax has long been a favorite in Spanish countries. In Mexico it exists as a stamp tax on all sales and at the rate of ½%. An extreme form of this tax (rate 10%), applied in Holland by the notorious Duke of Alva in the 16th century, was one of the chief causes of the revolt of that plucky little country against Spain.[2] The United States excise levy on liquor and tobacco is a form of this tax.[3]

IV. The Land-Sales Tax will fall on the landowner, because land cannot be indefinitely reproduced, like merchandise, and its price is therefore not set by cost of production but represents merely the capitalization of net yield after the essential costs of operation—wages and interest—have been met.[3]

V. The Real-Estate or Improved-Land Sales Tax comprises two levies, one on land and the other on its improvements. The first does not affect prices, as it falls on the legal privilege of land-owning; but the second falls on the economic capital represented by property such as buildings, and will therefore increase house rents.

VI. The Poll Tax is an annual sum collected from each citizen as such, irrespective of his wealth, and will fall on labor, capital, or land accordingly as the payer gains his income from one or more of these sources. This tax often represents a commutation in money of the medieval duty of every citizen to contribute, annually, one or more days of unpaid labor on the public roads. It tends to increase wages and, consequently, the price of commodities.

VII. The License Tax was the favorite local method of levying on liquor saloons until the inauguration of national prohibition. For a decade it has been used by the Nation in the form of a tax on corporations, assessed according to their capital, for a permit to do business. This tax will always fall on the consumer; except when its payer is exposed to free competition from other districts or countries, where the tax is not levied, in which case it may be found impracticable to shift it from the producer's shoulders.

VIII. The Land-Value Tax is the most direct form of levying on legal monopoly, as the ownership of land is by far the most important form of it. As far as I know, the earnings of patents and copyrights have never been specifically attacked by taxation, though they have undoubtedly been made to contribute through such levies as the Income, the Excess-Profit, and the Inheritance taxes. The Land-Value Tax agrees perfectly with the two Golden Rules and cannot raise the cost of living, because land rent has no effect on the price of commodities. Whether this tax be large or small is a personal matter between the landowner and the government; what the latter may gain the former will lose, as this tax cannot be shifted elsewhere.[4]

IX. The Unearned-Increment Tax is levied on the increase in selling value of land, computed between two transfers or, in default of such, at stated intervals. It has been adopted widely in Germany and England to absorb for society a portion of the future increase in land values, while leaving to the landowner that land value accumulated in the past which could only be absorbed by the Land-Value Tax itself. It was also used in Kiao-Chau, China, during German rule, as a means of avoiding undervaluation in the assessment of the Land-Value Tax. I consider this tax an awkward device, if used for the purpose of correct valuation, and one tending to complicate a correct settlement, later on, of the land question.

X. The Real-Estate Tax is a combination of the Unearned-Increment Tax with one on buildings and other landed betterments. As the latter levy affects capital, it tends to raise the rate of interest and house rent, and to discourage construction.

XI.—The Personal-Property Tax is designed as a levy on chattels of every kind from stocks and bonds to earrings and pug dogs. As most of these objects have a custom of disappearing, shortly before the visit of the assessors, this tax has never been much of a success as a revenue-getter. This tax rests on capital when applied to bank deposits or household goods, and on legal privilege when applied to shares in corporations owning land or patent rights.

XII. The General-Property Tax is a combination of taxes No. X and XI and has the same incidence and general effect. This still remains our favorite tax for local purposes; but, owing to the ease of evasion of No. XI, it operates in practice chiefly as a Real-Estate Tax.

XIII. The Income Tax in its simplest form may be a levy on labor, capital, or legal privilege, separately or in combination. In practice it is customary to exempt the incomes of manual laborers from the tax, so that any tendency it might have to lower the common standard of living may be avoided. Owing to the fact that the proportion of the national income produced by corporations is constantly increasing, the collection of this tax at its source renders its evasion at the present time much more difficult than it was half a century ago, when production was largely by individual entrepreneurs. Nevertheless, recent figures indicate that a large sum still evades the Federal assessor, and that many have enjoyed the premium for perjury that this species of taxation offers.

The surtax feature of the Federal Income Tax is designed to collect an extra sum from the larger incomes, on the theory that they proceed from investments rather than from the earnings of mental labor. But as no distinction is made between incomes that are obtained from the interest on true capital and those due to the rent proceeding from land ownership, the surtax is evidently a crude way of attaining economic justice. Moreover, this tax does not impede the speculation and monopoly

[2] 'Rise of the Dutch Republic', by John Motley.

[3] 'Mr. Ingalls and Walkerian Economics', in 'M. & S. P.', Nov. 1, 1919, p. 627; also 'Federal Taxation of Mines', discussion by myself, Trans. Inst. Min. & Met. Eng., March 1920, Bull. 159.

[4] 'Natural Taxation', by T. G. Shearman, Chap. VI.

of natural resources, as no levy is made until cash profit is actually received.

The decision of the Supreme Court in 1920, which exempted stock dividends from the Income Tax, enables corporations to evade this tax in the same way as the land speculators. If this tax were to be permanent the result, in the long run, might not be far different for the evaders; but the latter are hoping—and lobbying—to abolish the whole idea long before they get ready to 'cash in' on their profits.

The existence of huge issues of public bonds which are exempt from the Income Tax forms another serious obstacle to proper functioning. Although the exemption may help to sustain the market price of such bonds, it is evidently a case of "paying too dearly for the whistle". Instead of abolishing the Income Tax, as is the proposal of the monopolists' lobby, would it not be wiser to change the law so as to withdraw all exemptions not specified in the bonds themselves? And in the last case, these special issues should be paid off, or refunded as soon as possible on a non-exempt basis.

XIV. The Excess-Profit Tax is a modification of the Income Tax designed in England during the Great War with the object of making the war-profiteer 'divvy up' with the Government. As levied by our Federal government,[5] it now takes 20% of the net income, beyond the excess-profits' "credit" and up to 20% on the invested capital, and 40% on any income above this 20% of the capital. As the "credit" exempted from the profits before this tax is levied amounts to a minimum of 10% on the invested capital, it evidently includes all normal profits. This tax may therefore be considered as affecting only extraordinary profits, or such as generally proceed from the ownership of legal privileges or the practice of monopoly. In unusual cases, such profits might be due to special ability in the management. Of course in war times a dazzling rate of profit for efficient plants often was due to the fact that the Government pursued the policy of paying excessive prices for commodities in order to encourage the operation of inefficient plants.

In spite of the present hue and cry against the Excess-Profits Tax, as tending to maintain the high cost of living, I can see nothing in the theory of taxation to warrant such a conclusion. As it is levied on the *residual* profit, after all the normal charges for labor and capital have been paid, it is analogous to a tax on land rent, which cannot, normally, affect the price of commodities. The other accusation that the operation of this tax tends to restrict the amount of private capital available for new enterprises is certainly true, but so would any other tax. Our government cannot withdraw four billions of cash annually from the savings of its citizens, and spend it on war debts or preparations, and expect the money market to remain unaffected by the operation.

XV. The Inheritance, or Estate, Tax, as newly levied by the Federation[5] in addition to the same taxation long established in many States, varies in its rate—from 2% for estates between $50,000 and $150,000, up to 25% on any surplus above $10,000,000. This tax tends to fall on the privileges of land ownership or patent rights in its upper reaches, as few great fortunes arise from other sources.[6] With its $50,000 exemption for all resident testators, it does not affect a reasonable provision for natural heirs; and with its exemption of all bequests for public purposes it allows a testator to decide how his fortune shall be spent for the common good. It is an ideal tax for the purpose of extinguishing war debts; its chief fault lies in the lowness of its rates.[7]

Before 1912 the Budget was mainly derived from the Import and Excise taxes, both of which raised directly the cost of living. It is true that anyone could legally evade the latter tax by affiliating himself with the W. C. T. U., but few miners knew enough of either taxation or personal hygiene to achieve this happy result. Later, with the inauguration of the Federal Income Tax, part of the budget began to be derived from the incomes of the rich instead of from the wages of the poor, but it was not until the inauguration of war taxation in 1917 that the subject became of vital importance.

The extra three billions of revenue that we are now levying annually above the pre-war budget has been mainly derived from the Income, the Excess-profit, and the Inheritance taxes. The Import Tax has produced little, owing to the paralysis of European workshops, and the Excise Tax has been hard hit by the inauguration of national prohibition. Both of the latter taxes tend to raise the cost of living for the miner and consequently the cost of production for the operator, but the first three taxes do not affect prices, except in their influence on interest by lessening the quantity of private capital available for new enterprises; but this is a result produced by all taxation of savings, and there is no alternative but the taxation of wages in such a way as to reduce the general standard of living, thus causing disastrous social harm.

If the direct taxes, now yielding the main Federal income, are replaced by indirect ones like the tax on merchandise sales, it means more than the shifting of the burden of government from the shoulders of the coupon-clipping classes to the consuming masses, though that is bad enough. All taxes on consumption increase prices, not only by their face value but by an additional amount, sufficient to cover the interest and dealer's profit on the amount advanced. This addition is often greater than the tax itself and represents pure economic friction.

The most rational suggestion for improving Federal taxation seems to be the Ralston-Nolan bill, which proposes to tax the privilege of land ownership. By this plan, undeveloped lands, now almost free of the tax burden, would begin to contribute their quota, and land-speculation would be discouraged.

ROBERT E. BRINSMADE.

Ixmiquilpan, Hidalgo, Mexico, June 10.

[5] 'Federal Revenue Act of Feb. 24, 1919.'

[6] 'History of American Great Fortunes', by Gustavus Myers.

[7] 'Gold, Prices, and War Debts', 'M. & S. P.', August 16, 1919, p. 224.

Flotation Practice at Mount Lyell

By L. V. Waterhouse

*Introduction. The flotation plant at Mount Lyell was erected, primarily, for the treatment of copper ore from the Lyell Comstock mine. The erection of a plant was delayed by the general dislocation of business at the outbreak of the War, but finally it became possible to secure all the necessary machinery in Australia and to import motors. Operations commenced on February 17, 1916, with all the success anticipated.

The sulphides in the Lyell Comstock ore consist of chalcopyrite and pyrite, finely disseminated through a gray schistose gangue, usually decomposed. Bands of hard quartzite carrying sulphides also traverse the ore-body.

After operations were well established, trial lots of North Lyell silicious ore were put through the plant with such success that the mining department made arrangements to select underground in the stopes a lower-grade ore than the usual 6% smelting ore, to supplement the Lyell Comstock milling material, and finally it became possible to start a second shift. The North Lyell ore carries bornite, chalcopyrite, and pyrite in a silicious gangue, consisting mainly of a hard quartzite and some schist.

The following are typical analyses of the respective ores:

	Lyell Comstock	North Mt. Lyell
Copper, %	2.6	3.5
Silver, oz.	0.23	0.7
Gold, oz.	0.02	0.01
Silica, %	46.0	66.0
Iron, %	11.5	8.0
Barite, %	1.4	2.0
Alumina, %	15.5	7.7

For the year ended September 30, 1919, concentration results were as follows:

	Tons	Copper, %	Silver, oz.	Gold, oz.
Lyell Comstock	13,595	2.18	0.2	0.028
North Mount Lyell	14,873	4.74	0.88	0.008
Total ore	30,468	3.43	0.54	0.018
Concentrates	8,622	10.95	1.47	0.047
Recovery		90.41	77.79	72.41

Coarse-Crushing. Ore is received from the Lyell Comstock mine in self-discharging hoppered trucks of 10 tons capacity (159 cu. ft.). Six trucks make up an ore-rake, which is hauled by 10-ton Krauss locomotives of 60 hp., the tractive force being 6490 lb. This ore is received on three days per week at the rate of 120 tons per day. The ore from the North Mount Lyell mine is drawn in 1¾-ton trucks from bins at the top of the main Mount Lyell haulage. All ore is weighed on the main smelter Pooley 75-ton weigh-bridge. On account of limited bin accommodation, the ores are inadequately mixed, and consequently treatment has to be constantly varied as required by the different classes of ore.

The crude-ore bin is lined with discarded manganese-steel crusher-jaw faces, and the only attention required is the occasional renewal of steel lining-plates on the face of the bin.

An old Krupp crusher of the Blake type was utilized, with cast-iron body in a single piece. The back toggle was made a shearing toggle with twelve 1-in. rivets. Imported Sheffield manganese-steel jaw-faces have an average life of 6100 tons of ore crushed, against 4500 tons for Australian manganese-steel. The latter have shown large variations in quality, though the manganese contents are similar, probably indicating irregularities in the heat-treatment. The crusher is driven at 240 r.p.m. by a 9-in. camel-hair belt, and set to crush to 2 in. A fine water-spray is provided immediately above the jaw opening, to allay dust.

At the outset, considerable difficulty was experienced in wet weather in extracting Lyell Comstock ore from the crude-ore bin on account of its 'puggy' nature, its moisture at times reaching 10%. This was overcome by making an enlarged door opening, 4 ft. 3 in. long by 1 ft. 9 in. high, with a radial door 3 ft. 10 in. long, and sluicing the ore in the bin with just sufficient water to form a slurry of the fine. The coarse ore discharges readily from the end of the conveyor into No. 2 fine-ore bin, while the slurry adheres to the conveyor belt, passes around the delivery drum, and is scraped off into a launder that delivers to the 'raff' elevator. It is thus immediately eliminated and treated. The adoption of this 'wet system' has rendered it possible to handle this class of ore without the least difficulty or loss of tonnage, and is an important factor under local conditions.

Fine-Crushing. Ore is delivered to the screens from the fine-ore bins, which are fitted with ratchet-doors, by means of corrugated roller-feeders, and the undersize is thereby eliminated before roll-crushing.

The screens are of the Broken Hill North type. Perforated steel plates, with holes either 7/64-in. diam. by 0.194-in. centres by 16 gauge, or ⅛-in. diam. by 0.22-in. centres by 14 gauge, are used. They have an average life of 2150 tons of crude ore screened. Soluble copper from the Lyell Comstock open-cut at times materially reduces the life of the screen-plates. The connecting-rods are built up of three plies of 4-in. by ½-in. ash, with ¼-in. plate cover. The screen is set at a 5° slope, and half the screen is below water-level. The power required is about 2 hp. each. Holes are bored in the screen-boxes, so that surplus water overflows into the iron-lined chutes, leading to the rolls. The undersize passes out of the screen-box through a 1¼-in. diam. wooden plug, and the discharge averages 25% solid.

The oversize passes through the rolls, then is elevated

*From the Proceedings of the Australasian Institute of Mining & Metallurgy, No. 38.

by the 'raff' elevator back to the screens. The flanged roll is belt-driven by 11-in. camel-hair belting, and the plain roll is gear-driven through twin wheels, the speed being 24 r.p.m. Chrome-steel roll-shells have a life of 9000 tons of ore crushed, against 5100 tons for carbon-steel shells.

The screen undersize is elevated in the 'fines' elevator and passes through the sampler to a diaphragm-cone classifier and dewaterer with an automatic regulator, as in Fig. 1.

The sliding weight requires adjustment for the two ores, greater leverage being necessary for that of North Mount Lyell. An arrow attachment in a prominent position serves to indicate the position of the cast-iron plug,

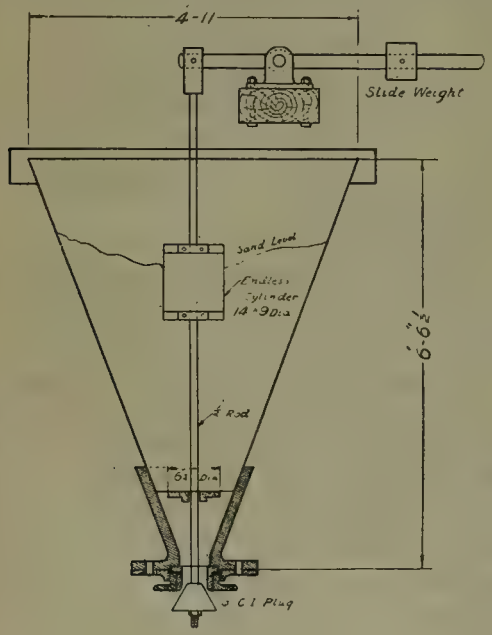


FIG. 1

and is useful in detecting irregularities, which are very rare, as the regulation is almost perfect. The cone discharge averages 26% moisture. The plugs have a life of four months and the suspension-rods two months.

The following are typical tests on the cone products:

	Lyell Comstock			North Mount Lyell		
Mesh,	Feed,	Spigot,	Overflow,	Feed,	Spigot,	Overflow,
I.M.M.	%	%	%	%	%	%
+ 20	47.7	62.2	...	63.6	65.9	...
+ 40	14.4	12.6	...	12.3	15.0	...
+ 60	7.1	5.5	...	4.2	5.8	...
+ 90	6.8	10.2	...	4.2	4.5	0.36
+120	5.5	1.2	2.5	3.9	2.8	1.1
+150	3.7	6.4	3.8	1.1	0.8	1.2
—150	14.8	1.9	93.7	10.7	5.2	97.34

TUBE-MILLING. On account of the limited room available for the plant, gear-driven tube-mills were adopted. These are driven by 75-hp. motors, and have flexible couplings on both rotor and counter-shafts. For the purpose of standardizing motor-speeds generally in the plant, 750 r.p.m. motors were used, but this high pinion speed cannot be recommended. 'Fabroil' pinions have a life of about five months, but better results are obtained with locally-made phosphor-bronze pinions, run in an oil bath, in which case phosphor-bronze bearings are used on the rotor-shaft. The mills are run in both directions of rotation, thereby extending the life of pinions and inside liners.

The mills are 16 ft. long by 5 ft. diam., with a hollow trunnion bearing on the feed end, and a forged-steel tire 2 ft. $9\frac{5}{16}$ in. diam. running on cast-steel rollers on the discharge end. The shell is built in three sections, bolted together by means of heavy angle-irons. The cast-iron liners, which are ribbed, are made locally, and have a service of about 25,000 tons. The wear on the end liners, which are also ribbed, is more severe, and these are replaced individually as required.

The mills are equipped with scoop-feeders with a radius of $12\frac{5}{8}$ in., and through these the daily charge of pebbles is fed. Owing to the irregularity in supply and

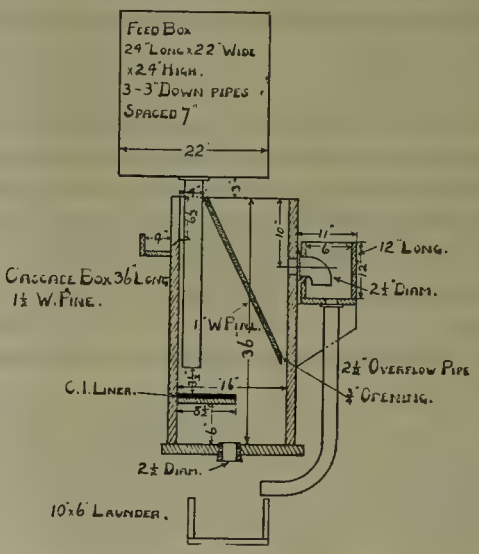


FIG. 3

quality, and also the high cost of flint pebbles, Tasmanian quartzite pebbles are now used. These average $2\frac{1}{2}$ to 4 in., and the consumption amounts to 11 lb. per ton of ore.

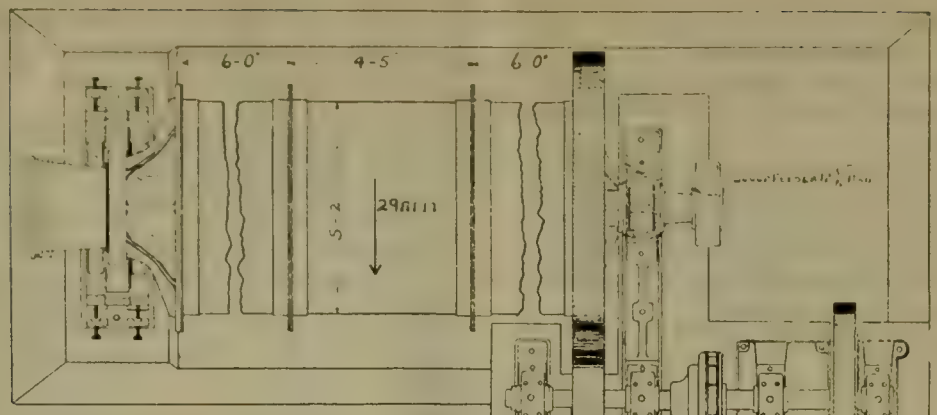
Fig. 2 shows the general arrangement of a tube-mill.

The following tests exemplify the work of the tube-mills:

	Lyell Comstock		North Mount Lyell	
Mesh,	Feed,	Discharge,	Feed,	Discharge,
I.M.M.	%	%	%	%
+ 20	62.2	...	65.9	...
+ 40	12.6	2.1	15.0	2.4
+ 60	5.5	6.2	5.8	6.9
+ 90	10.2	15.4	4.5	13.0
+120	1.2	8.7	2.8	8.1
+150	6.4	3.1	0.8	5.1
—150	1.9	64.5	5.2	64.5

The moisture averages 26%, namely, that of the cone-spigot product; and the rise of temperature is 18°, from 56° to 74°F.

DORR THICKENERS. Two Dorr thickeners take the overflow from the diaphragm-cone classifier, and are of the standard design for 20-ft. diam. tanks. No overload



Motor by G. E. Co., Schenectady. Type I., Form M., 75 h.p., 750 r.p.m., 500 v., 50 cycles, 3 phase.

Motor Pinion 20 teeth, 10 in. p.c.d., 6½-in. face, phosphor bronze.

Intermediate Spur Wheel 114 teeth, 57 in. p.c.d., 6-⅞in. face, cast iron.

Intermediate Pinion 22 teeth, 19¼ in. p.c.d., 9½-in. face, cast iron.

Spur Wheel on Mill 100 teeth, 90-⅞ in. p.c.d., 9½-in. face, cast iron.

Flexible Couplings, Laced Belt Type. Motor shaft coupling has 2½ in. x 4 ply Balata belt. Intermediate shaft coupling has 4 in. x 4 ply rubber belt.

FIG. 2. ARRANGEMENT OF TUBE-MILL

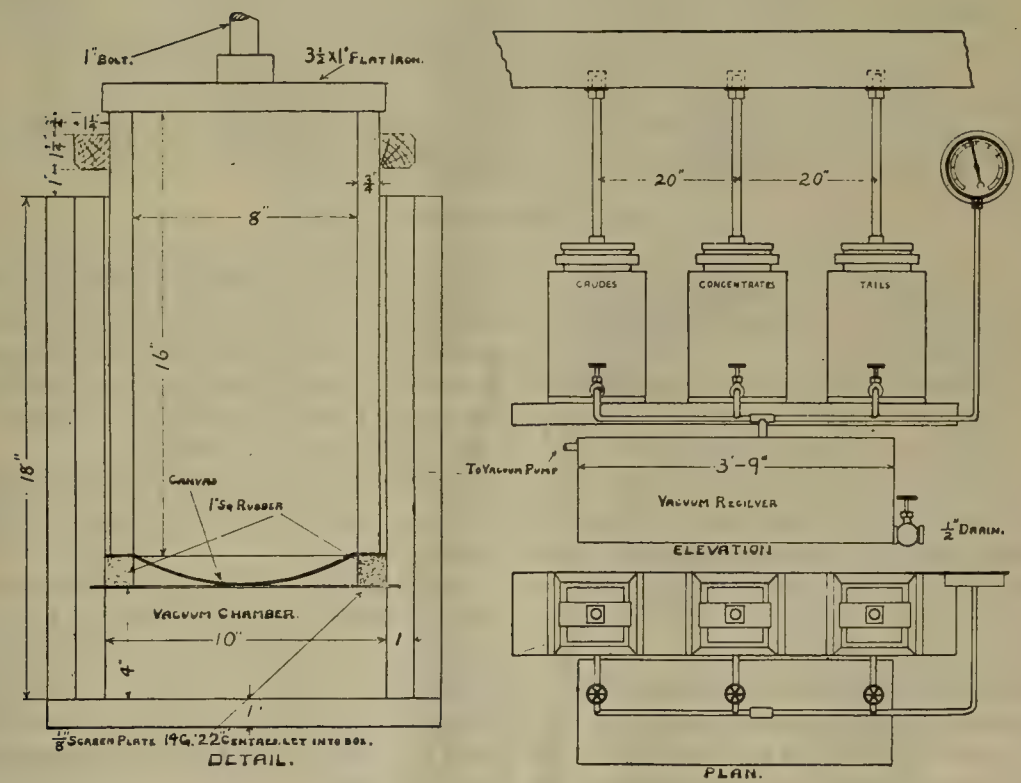


FIG. 5. DETAILS OF SAMPLE-FILTERS

alarm is used, and an examination of the spring at starting is all that is necessary. The speed is ⅛ r.p.m., and the discharge averages 40.0% solid.

The tanks are of steel construction, with $\frac{3}{16}$-in. shell and ¼-in. bottom. Gate-valves on a 4-in. pipe regulate the discharge.

The feed is laundered into a wooden box, 2 ft. square by 1 ft. deep, with a central pipe 8 in. diam. that extends 12 in. below the surface, covered by a screen to collect chips, etc. A diving-ring, 30 in. diam. by 48 in. deep, of $\frac{1}{16}$-in. plate, concentrically surrounds this pipe and prevents any surface eddies.

Flotation. The tube-mill and thickener discharge join in the boot of the feed-elevator, which delivers to a phragm-cone discharge before being split between the two mills, and eucalyptus oil to each tube-mill through ¼-in. pet-cocks from pipes connected to a supply-tank. The consumption of tar is 0.1 lb. and of eucalyptus oil 0.8 lb. per ton of ore.

Compressed air is introduced immediately under No. 1 stirrer in limited quantity, and tends to produce a crisper float on the first boxes.

The float from the last four spitz-boxes is returned as a middling to the feed-elevator.

The dilution of the flotation boxes is maintained at about 4½:1. On account of the difficulty in settlement of the slimed gangue of the Lyell Comstock ore and its tendency to sicken the float and lower the grade of con-

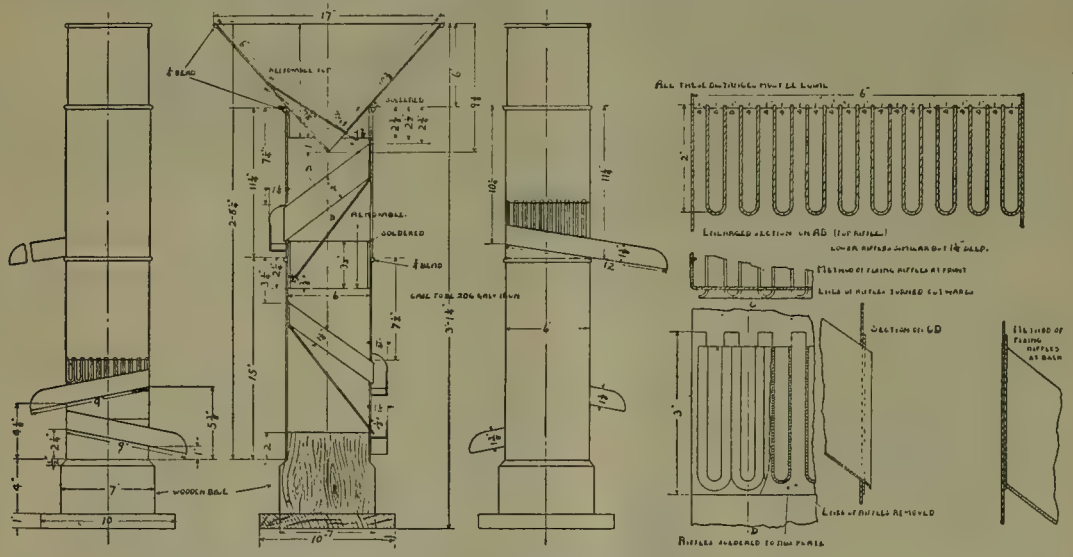


Fig. 4. SAMPLE-REDUCER

balance cone, 2 ft. 6 in. diam. by 3 ft. 6 in. deep, at the head of the flotation boxes. Pebble fragments that escape the grating of the tube-mills are caught on a screen at the elevator boot.

The main flotation unit is of the standard Minerals Separation type, and contains 12 agitation and spitz-boxes. The agitation boxes are 2 ft. 3 in. square by 3 ft. 10 in. deep, and have cast-iron liners. The stirrers are four-bladed, 19 in. diam., revolving at 320 r.p.m., driven by a ¼ twist-drive of four-ply 4-in. Balata belt, and the 2-in. shafts are equipped with S.K.F. radial and thrust-ball races. The line-shaft, which is 4 in. diam., is equipped with five S.K.F. ball-races and driven by a 75-hp. motor with 14-in. camel-hair belting. Two-bladed paddles, revolving at 19 r.p.m., are provided for skimming off the float at the lip of the spitz-boxes.

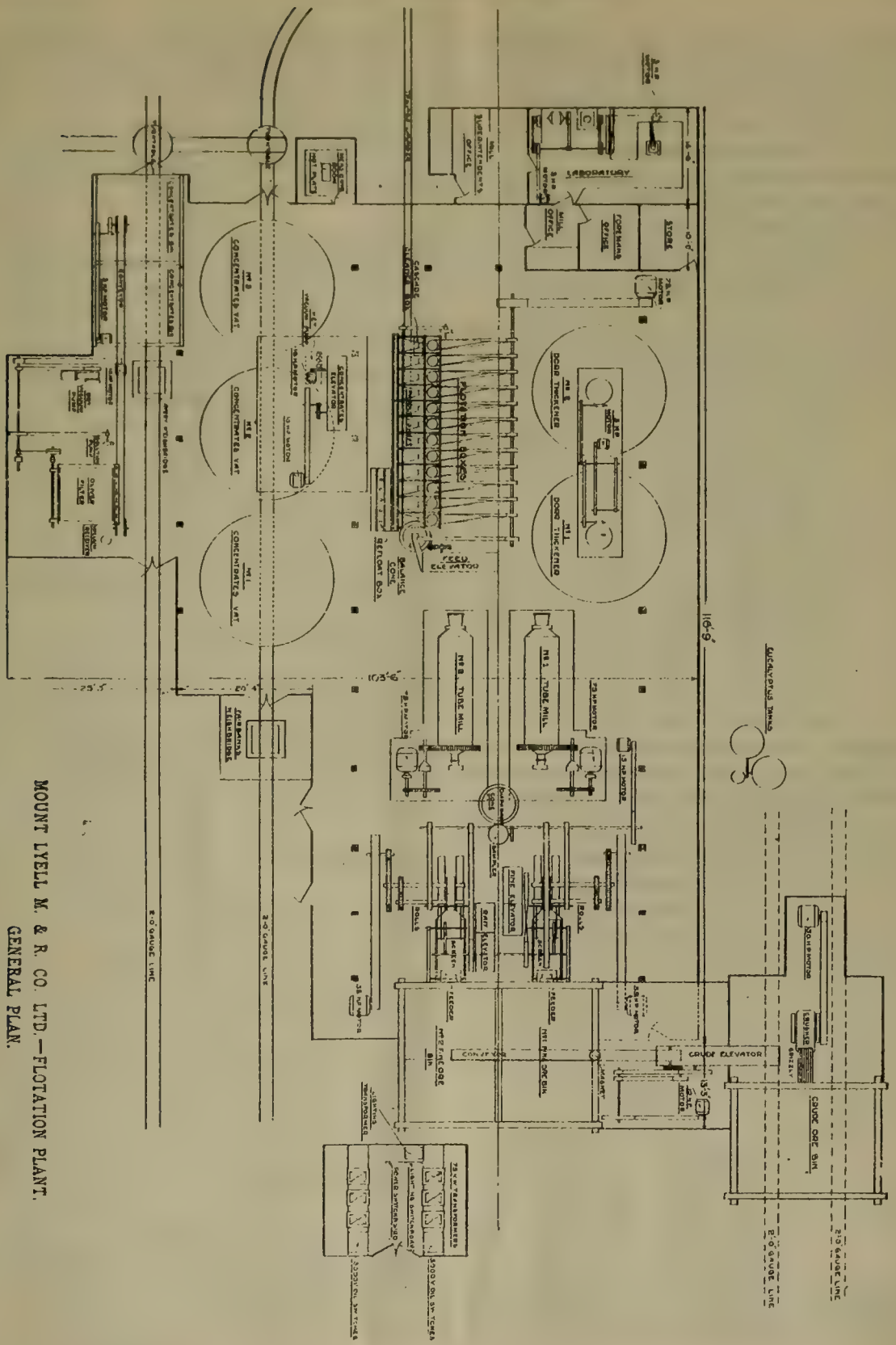
The addition of frothing media is made to the tube-mill feed, with such additions as may be necessary at the flotation boxes, generally only at starting up, until the thickener flow is normal and regular conditions are obtained. A mixture of one part of eucalyptus oil to two parts of coal-tar is fed by a disc-feeder to the dia-centrate, the flotation section is arranged in open circuit, that is, there is no return tailing-water.

Sulphuric acid is not found to be necessary in the treatment, although indicated in the experimental investigation of North Mount Lyell ore. The improvement in the grade of concentrate by the use of acid is offset by the drop in the recovery.

The flotation solutions are not heated, but conditions improve with a rise in temperature. The temperature of solution varies from 47° in winter to 74°F. in summer.

As the height of the discharge from the flotation boxes above the tailing-launder was sufficient to place a single cascade-box, a unit, as shown in cross-section in Fig. 3, was subsequently installed. This box acts as a tailing-scavenger and returns some pyrite as a middling, and at the same time is a guide in the operation of the flotation boxes, as it indicates changes in dilution and irregularities in the float.

A separate flotation unit, the subject of my Australian patent 2353/16, was installed to re-treat the concentrate from the M. S. flotation boxes. It consists in forcing



MOUNT LYELL M. & R. CO. LTD.—FLOTATION PLANT.
GENERAL PLAN.

atomized air into the oiled pulp, in a launder-shaped box, by means of high-pressure water through an ejector.

Water at 80-lb. pressure, through a $\frac{3}{16}$-in. jet in the ejector, is used. Excellent results have also been obtained on crude-ore pulp, as well as in re-treatment of concentrates. The quantity of water returning with the middling from this unit, in addition to returns from the main boxes, filter, and cascade cleaner, produces an excessive circulation, and since the introduction of the cascade cleaner this re-treatment unit has not been in constant operation, although conditions in the main boxes were improved by the addition of the emulsified solution.

The same type of water-pressure ejectors is used to pump out the overflow-pits, adjoining the elevator-boots.

The following test on flotation products was made mainly on North Mount Lyell ore:

	Mesh, I.M.M.	Weight, %	Copper, %	Iron, %	Insol. %	Recovery, %
Feed	+ 40	4.72	1.8	6.4	...	...
	+ 60	10.14	2.17	8.3	...	...
	+ 90	15.36	2.35	9.2	...	...
	+ 120	9.23	2.45	9.8	...	...
	+ 150	4.11	2.9	10.1	...	...
	— 150	56.44	3.12	8.7	...	...
	Bulk	100.00	2.77	8.78	...	...
Concentrates .	+ 40	1.17	8.25	26.6	37.3	56.1
	+ 60	6.47	7.5	25.2	36.8	75.9
	+ 90	11.7	8.1	26.6	32.2	81.4
	+ 120	8.46	8.6	28.6	28.6	91.1
	+ 150	5.08	9.3	29.8	24.1	96.8
	— 150	67.12	10.9	24.8	32.0	95.2
	Bulk	100.00	10.01	25.5	34.6	90.9
Tailings	+ 40	6.4	0.9	3.8	...	...
	+ 60	10.6	0.68	2.5	...	...
	+ 90	14.8	0.45	1.6	...	...
	+ 120	4.5	0.3	1.25	...	...
	+ 150	4.0	0.28	1.25	...	...
	—150	59.7	0.21	1.79	...	...
	Bulk	100.0	0.34	1.89	...	...

FILTERING. Three steel draining-tanks, 30 ft. diam. by 8 ft. deep, with the usual filter-bottom, consisting of a grating covered with hessian and coco matting, were originally provided, also a wet vacuum-pump. Froth-rings and overflow launders were attached. After one week's drainage the moisture averages 15%.

Subsequently an Oliver continuous-revolving drum filter, 8 ft. diam. by 8 ft. long, having a filter area of 200 sq. ft., was installed, and has given excellent service. The concentrate is elevated to the filter direct from the M.S. boxes without any thickening, and averages 52% moisture. The drum makes one revolution in eight minutes, the cake thickness varies from $\frac{1}{4}$ to 2 in. and contains 11.5% moisture.

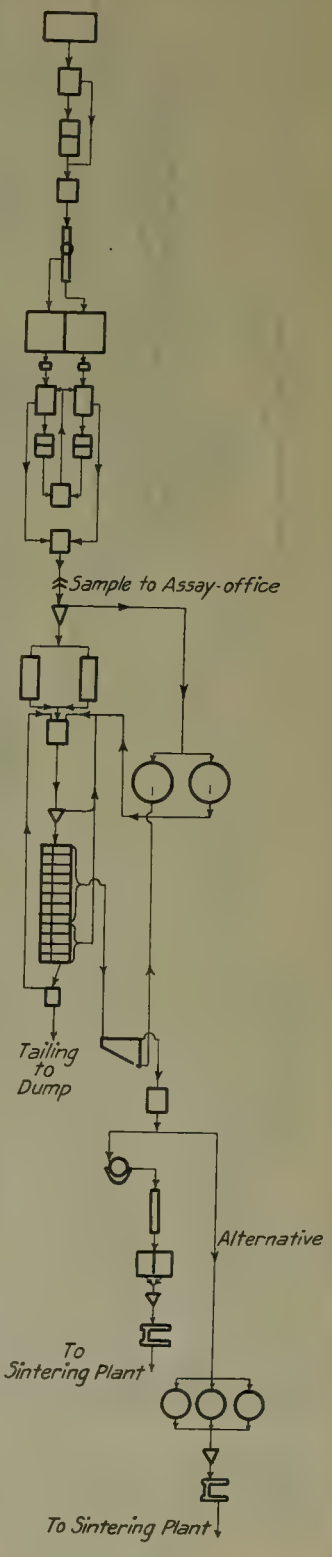
The following test indicates the work of the filter:

Water in feed..... 52.0%
Water in cake..... 11.5%
Vacuum ..... 22 in.
Estimated capacity ..... 600 lb. per sq. ft. per 24 hours

	Grading				
Mesh, I.M.M.	Weight, %	Copper, %	Iron, %	Silica, %	Alumina, %
+ 60	6.4	14.85	23.0	26.0	0.6
+ 90	8.6	9.45	26.5	27.4	1.2
+ 120	7.5	10.9	27.0	22.6	3.9
+ 150	6.3	11.7	27.2	21.6	4.6
— 150	71.2	9.55	23.9	21.0	6.5
Bulk	100.0	10.11	24.5	22.0	5.35

The depth of pulp varies with the working of the filter, and submerges the drum up to 3 ft. 6 in., lower levels yielding a dryer cake and higher levels a greater capacity.

No steam-raising of the temperature of the pulp has been tried, but the experience of others is that it yields a drier cake and increases capacity.



Ore-bin, capacity 130 tons, receiving mine-size ore from Comstock and North Lyell mines, 35° rill.

Grizzley, 5 ft. by 2 ft. 3 in. bars, spaced one inch.

Jaw-crusher, 19¾ by 12 in.

Crude elevator, 33 ft. 3 in. centres, inclination 75°, 12 in. wide, 8-ply balata belt, speed 380 ft. per min. Buckets 12 by 6 by 5 ft., spaced 15 in.

Conveyor, 18 in. wide, 5-ply belt, centres 30 ft., inclination 8°, speed 275 ft. per min.

Electro-magnet, 19 in. diam.

Fine-ore bins, rill 45° each, 150 tons capacity.

Corrugated-roll feeders, 20¾ in. face by 20 in. diam.; 2 r.p.m.

Submerged type shaking screens, 240 1½-in. strokes per min., 1/8 or 7/64-in. opening.

May Bros. rolls, 50 by 15 in., 24 r.p.m.

Elevator, 25 ft. 9 in. centres, inclination 80°, 12 in. wide, 8-ply balata belt, speed 367 ft. per min. Buckets 12 by 6 by 5 in., spaced 9 in.

Elevator, 35 ft. 6 in. centres, inclination 80°, 12 in. wide, 8-ply balata belt, speed 415 ft. per min. Buckets 12 by 6 by 5 in., spaced 9 in.

Sampler, double-cone cut 1/3280.

Diaphragm cone-classifier, 4 ft. 11 in. diam. by 6 ft. 6 in. deep, 6½-in. diaphragm, 1½-in. annular opening, automatic control.

Tube-mills, 16 by 5 ft., 29 r.p.m., motor-driven through gears; flexible coupling on rotor and counter-shafts.

Elevator, centres 27 ft. 6 in., inclination 80°, 12 in. wide, 8-ply balata belt, speed 350 ft. per min.; buckets 12 by 6 by 5 in., spaced 9 in.

Dorr thickeners, 20 ft. diam., 10 ft. deep, ⅛ r.p.m.

Balance-cone, 2 ft. 6 in. diam. by 4 ft. 4 in. deep.

M. S. flotation machine, 12 compartments, 18 in. diam. stirrers, 320 r.p.m.

Cascade cleaning-box, 5 ft. long by 10 in. wide by 2 ft. 6 in. deep.

Re-float box, Waterhouse patent.

Elevator, centres 40 ft. 3 in., inclination 80°, 12 in. wide, 8-ply balata belt, speed 367 ft. per min.; buckets 12 by 6 by 5 in., spaced 24 in.

Oliver filter, 8 ft. diam. by 8 ft. face; ⅛ r.p.m.; filter-area 200 sq. ft., vacuum-pump 3½ in. diam., 8-in. stroke, 250 r.p.m.

Conveyor, 14 in. wide, 4-ply belt, 137 ft. per min., centres 50 ft. 6 in., 26° level.

Concentrate bins, hoppered, capacity 80 tons.

Bochum trucks, ¾-yd. capacity.

Avery weighbridge, capacity 60 cwt.

Concentrate draining vats, 20 ft. diam. by 8 ft. deep.; filter bottoms connected to wet vacuum-pump.

Bochum trucks, ¾-yd. capacity.

Fairbanks weighbridge, capacity 60 cwt.

The drum is wound, over the canvas, with 14-gauge copper-clad steel wire, the turns being about 2 in. apart. It takes about 16 hours to re-canvas and re-wire the drum. The canvas lasts about eight months, and the hessian under the canvas two years. One recent canvas handled 5157 tons of concentrate. The canvas is occasionally hosed and scrubbed. The scraper requires particular attention, and is periodically filed, reversed, or renewed.

The air-lifts and emergency air-agitation pipes were not found satisfactory, and were discarded. The speed of the mechanical agitators was increased to 74 r.p.m. The original agitator-shaft consisted of a heavy 3-in. pipe flanged to stub-shafts on each end. It was soon found necessary to use a solid 3-in. shaft. Wrought-iron paddles, 9 in. apart, and placed alternately to right and left to avoid thrust, have been used, but, on account of the presence of copper in solution, cast-iron paddles are now being tried.

The attendant on the flotation boxes also operates the filter, which requires a minimum of attention.

The filter delivers the concentrate onto an 18-in. inclined conveyor, which, in turn, delivers to the bin.

The concentrate is loaded into ¾-yd. Bochum trucks, and drawn to the smelter, distant about 200 yards, by horse.

Sampling. The feed sample is taken in the fine-crushing section by a sampler developed on the Broken Hill South mine, consisting of two inverted hollow cones, rotating on the same axis in opposite directions at different speeds, and having knife-edge cuts through them at different radii from the above axis.

Grab-samples are taken of concentrate and tailing at regular intervals for daily record. Filtered concentrate is officially sampled as dispatched to the smelter by means of cheese-samplers.

The pulp-samples are reduced in the machine shown in Fig. 4. The reducer is made in three parts for the purpose of cleaning and inspection.

On account of the difficulty in settlement of slime and the distance of the assay-office from the plant, filters for samples were devised, and have proved useful. Fig. 5 shows the arrangement and general details.

Elevators are framed of 6 by 3-in. Oregon pine with 6 by ⅜-in. pine lining. The width between lining is 2 ft. 2 in., and the depth 6 ft. All top and bottom drums are 36 in. diam. by 15-in. face by $\frac{5}{16}$-in. crown by 4-in. shaft, with ring oil-bearings on top and solid bearings with brass bushes on the bottom.

All belts are 8-ply Balata, 12 in. wide, and driving-belts 6-ply Balata, 6 in. wide. Buckets are riveted mild-steel plate; they weigh 7½ lb. and have 190 cu. in. capacity.

Sand-guards are provided on the bottom shaft, a deflecting saddle, at 45° above the drum, carrying rubber scrapers, and adjustable lips at the discharge. The centre of the top drum is 3 ft. 9 in. above the discharge lip, which gives a satisfactory delivery at the speeds employed.

The belts for elevating the feed and concentrates have been running for four years without renewal. The belt that elevates the crude ore has the most severe duty, and lasts about 35 weeks, or 23,000 tons, against 58,000 tons for the raff-elevator, and 44,000 tons for the fine-elevator.

The sulphide of cadmium is a brilliant pigment, states a U. S. Geological Survey bulletin. If properly prepared it is one of the most permanent pigments known, and is unaffected by hydrogen sulphide gas from coal smoke, whereas the common yellow pigments are blackened in a smoky atmosphere. Cadmium-yellow is therefore employed as a protective coating over chrome-yellow in painting street cars and the passenger coaches on some railway lines. Sulphide of cadmium is used extensively to give color and lustre to glass and porcelain; other cadmium salts are used in dentistry, dyeing, and photography. The so-called cadmium lithopone, which is analogous to lithopone and in which cadmium replaces the zinc, has been experimentally known for some years. Hanley says: "It is believed that the pigment industry offers a good prospective field for the consumption of cadmium compounds. Cadmium-yellows and cadmium lithopone constitute the principal forms used, and the persistence of the color is a favorable feature of these pigments. They can therefore be used advantageously in an atmosphere vitiated with sulphur smoke, whereas the chrome-yellows darken under similar conditions. Cadmium has long been used by artists who require beautiful and persistent yellow or orange tints. The sulphide, which is the form used in paints, will stand considerable dilution with a transparent thinner, such as heavy spar, without losing the intensity of the yellow color. It may be possible, therefore, to develop a color using this pigment that could compete in price with cheaper yellows. This proposition would require development by experienced paint chemists in order to be definitely established. The shade of color can be accurately controlled from light yellows to deep vermilions by regulating by hydrogen sulphide the acidity of the cadmium sulphate solution from which it is precipitated. Consequently the color required by the trade could be consistently duplicated." Cadmium electroplating is a field that offers some promise of expansion. Cadmium is a better rust preventive than nickel, and at more nearly a parity in prices cadmium plating might be substituted for nickel plating on some articles. Or, as it has a greater tendency to tarnish than nickel, it might be used in combination with nickel, the first coat consisting of the rust-preventive cadmium and the second coat of the tarnish-proof nickel. The Udylite Process Co., of Kokomo, Indiana, has developed a commercial method for electroplating iron and steel articles with cadmium and is prepared to grant licenses for its use.

The greatest depth yet found in any ocean is 32,088 ft., at a point about 40 miles north of the island of Mindanao, in the Philippine Islands, states the U. S. Geological Survey.

Factors in the Production of Iron and Steel on the Pacific Coast

By Clyde E. Williams, Metallurgist, U. S. Bureau of Mines

*The question of the establishment of an iron and steel industry on the Pacific Coast has been the subject of discussion and investigation for many years. Such an industry is necessary if the West Coast is to develop and make the most of its wonderful natural resources. The cost of shipping iron and steel products from Eastern points to the Pacific Coast increases their cost one-half if shipped by water and two-thirds if shipped by rail. This same relation held before the War, when the cost of iron and steel and transportation rates were both lower.

Admittedly, cheaper iron and steel are needed. Whether these can be obtained by producing them upon the Pacific Coast depends upon a number of factors. Chief among these are: (1) the supply of raw material; (2) the amount and nature of the market; (3) the size and type of smelting operation.

Coke. The vital factor in successful blast-furnace smelting is coke. Iron ore can be brought from great distances cheaply, but it is costly to transport coke. Coke represents one-third of the weight and one-half of the volume of the ordinary blast-furnace charge. Normally from 20 to 30% of the cost of production is due to coke. There are two outstanding characteristics that the coke must have. First, it must be cheap, and, second, it must have the mechanical strength to support the weight of the charge and sufficient hardness to resist too rapid solution by the ascending gases.

There are several coals of good coking quality in the State of Washington. These coals are high in ash and must be washed before being used in the coking process. Even with careful washing, however, the best coke that can be made from these coals contains 15% or more ash. Perhaps the best supply of coking coal for the present consideration is that in the Wilkeson-Carbonado-Fairfax district in Pierce county. Coke made from this coal has suitable physical properties and is sufficiently low in sulphur and phosphorus to be desirable for use in the blast-furnace. Its high ash-content will make necessary the use of more coke than is ordinarily the case, and hence the cost of smelting will be greater. There is some coal in this district whose content of ash can be lowered by washing to 7.5%. Coke made from this product would contain only 12% ash. Unfortunately, however, this coal is said to be non-coking.

There are coking coals in British Columbia at Cassidy and Cumberland on Vancouver Island, and in Nicola valley and Crows Nest Pass on the mainland. A coke is being made in by-product ovens at Anyox by mixing the high-volatile coal found at Cassidy with the low-volatile coal obtained elsewhere. It is said that this coke has suitable physical properties for use in the blast-furnace. The ash-content is high and it is doubtful if any coke can be made from British Columbian coals that will be lower in ash than that made from the Pierce County coal. Indications are that the ash-content will be higher.

A large quantity of coking coal has not been developed in Oregon. It is said, however, that the Eden Ridge (Coos county) coal is of coking quality.

California has no coking coal. Utah coke of excellent physical qualities and low ash is available, but only after a long rail-haul that approximately doubles the cost of the coke.

From the above information it is evident that coke is available in British Columbia and in Washington, that this coke is suitable for blast-furnace use, and that its cost will be more than the cost of coke in Eastern districts because of its high ash-content and the higher cost of mining it. Coke should not be moved great distances, and Utah coke should not be shipped to California. The smelting centre should be near the coke-supply in Britsh Columbia or Washington.

Iron Ore. The presence of iron ore near the smelting locality is not so important as is the presence of coke. Iron ore can be shipped as ballast cheaply from great distances. No large deposit of iron ore is found in Washington. However, if a smelter were established in the North-West, the many small deposits would undoubtedly be drawn upon.

Magnetite occurs in British Columbia on Texada, Louise, Redonda, and Vancouver islands, and on the mainland to the north of these islands. Some of these deposits contain as much as 60% iron and some only 50%. In some instances, the content of sulphur and copper is so large that the ores must first be purified; in others, no pre-treatment is necessary. A large tonnage of these ores is said to be available, but their true extent and composition will only be determined when a market has been established and large-scale mining operations are carried out.

There is a vast supply of high-grade hematite ore in southern California in the Eagle mountains, of Riverside county, and in the Cave Canyon district and in the Providence mountains of San Bernardino county. These ores are rather far inland, but fortunately not far from a railroad. It is probable that other ores nearer tidewater can be obtained at less expense.

Large supplies of high-grade hematite occur in Mexico, the most accessible to the Pacific Coast being those on

*A paper presented at the International Mining Convention at Portland, Oregon, on April 7, 1921.

the west coast of Lower California at St. Vincent. Other deposits in Mexico near the west coast are in the States of Guerrero, Michaocan, and Oaxaca. These ores could be brought to the North-West on returning ships that carry lumber to the Southland. In the same way, the rich Chinese ores could be brought over on ships that carry goods from Pacific Coast ports to the Orient. If this country is to engage in a profitable export business with the Orient, our ships must not return therefrom without cargoes.

Summarizing the facts, sufficient ore of good quality can be brought to an iron smelter on the Pacific Coast; the rich ores of the west coast of Mexico and of China offer the greatest potentialities; the magnetites of British Columbia are available at tide-water, and the hematite of southern California can be obtained at tide-water after a rail-haul of about 200 miles.

LIMESTONE. The limestone at Roche Harbor, on San Juan island, that near Blubber Bay, on Texada island, and that near Cape Flattery, on Vancouver island, are available for use in the Puget Sound region. Sufficient limestone to maintain a plant in southern California may be obtained in San Bernardino county.

REFRACTORIES. Clay for refractory purposes is available at Clayburn in the south-western part of British Columbia, just across the line into north-western Washington at Sumas; also at Clayton, and Freeman, near Spokane, and at Moscow and Troy, both in Idaho. That at Clayburn is now being made into good firebrick and that at Sumas can be mixed with Kummer (Washington) flint, an excellent brick being obtained.

MARKET. Much difference of opinion exists as to the scope of the market for iron and steel on the Pacific Coast. It is difficult to obtain reliable data. The customers are scattered over such an extensive area, and their purchases are so variable in amount and kind that it is almost impossible to obtain information from them. Those whose purpose it is to promote the establishment of an iron and steel industry on the Pacific Coast, such as Chambers of Commerce and similar organizations, are prone to be too enthusiastic. Their quantities are usually several times too large. On the other hand, the iron and steel corporations, when asked to establish such an industry, will quote statistics that are much more conservative, perhaps more nearly representative of the conditions, but undoubtedly on the smaller side of the scale. However, in this discussion the important factor is not so much what the present consumption is but what the consumption would be if cheaper iron and steel were available.

No pig-iron is produced on the Pacific Coast. Most of that used comes by rail from the East. Small amounts arrive from time to time from China and occasionally from Great Britain and elsewhere. Two hundred tons of pig-iron is consumed daily, practically all of it being used for making gray-iron castings. With cheaper pig-iron the present output of castings will be increased, and thus the market for foundry iron will become larger.

The production of steel in California, Oregon, Washington, and Utah is 1000 tons per day. Scrap-iron and scrap-steel are used almost entirely because they are cheaper than pig-iron. Cheap pig-iron would replace a large portion of this scrap. The steel-makers would like to use part pig-iron in the charges to the furnaces because at times scrap is hard to get, its cost increases with the demand, and a mixture of part scrap and part pig-iron is more desirable from the standpoint of melting.

Although the total consumption of steel on the Coast is large, it consists of many different sizes and shapes, without a large continuous consumption of any one. Steel rolling-mills are complex and expensive and to be operated profitably must have a large production. It would be impossible to construct and operate a mill to produce so large an assortment of sizes and shapes on the small scale necessary to prevent flooding the Pacific Coast market. Those products must be made for which there is a large steady demand or which can be made by the same machinery. An example of a product for which there is sufficient demand to take the output of a modern rolling-mill is tin-plate. The consumption of tin-plate and tin-cans in California, Oregon, Washington, British Columbia, and Alaska amounts to 150 tons daily, and the amount exported through Pacific ports to 100 tons. Hence, a market exists for 250 tons daily, and it is reasonable to suppose that a portion of this market could be absorbed by a producer on this coast.

The market for steel products will grow as the West grows; each will help the other. At the present time, however, there is little opportunity for the development of a large steel industry. The development to be anticipated will come through the slow and substantial growth of the present producers, increasing their output and developing new products (such as tin-plate) for which there is a sufficient market.

Pig-iron produced on the Coast, if cheap enough, will be used by the foundries for making gray-iron castings and by the steel works as a partial substitute for scrap-iron and scrap-steel. The amount of pig-iron that will be consumed will depend upon its cost. There is sufficient outlet through these two sources for the output of one blast-furnace of about 400 tons capacity. A cheap source of pig-iron once established, new industries will spring up, consumption of iron castings and steel products will increase, and thus a larger production of pig-iron will gradually become possible.

Japan is expanding her steel industry rapidly. Not sufficient ore is found in Japan, so ore and pig-iron are being brought to Japan from China. The production of iron and steel is now between 550,000 and 750,000 tons per annum. The consumption is between 1,500,000 and 2,000,000 tons per annum. Japan, therefore, will be an importer of American iron and steel products for some time. However, her industry is expanding so rapidly that the time is coming when she will be able to take care of herself. Whether this expansion will become great enough for Japan to export to America and therefore compete in the Pacific Coast States is questionable.

Much has been said in the past regarding the importa-

tion to this country of cheap Chinese pig-iron. It is true, Chinese pig-iron has been laid down on the Pacific Coast for less than pig-iron from eastern United States could be. But there is no danger of any great competition from this source. The so-called cheap Chinese labor is not cheap when reduced to terms of output per dollar. Coke is available in China, but it is expensive. Considering all things, the cost of producing pig-iron in China is comparatively high; and China, rather than engaging in the production and exportation of iron, will become an active consumer, particularly of steel products.

Another factor entering into a discussion of markets is the attitude of the Eastern producer. In order to hold

his present market on the Pacific Coast, he will fight any competitor on the Coast by cutting costs. On some products it is likely that the reduced cost will be comparable with the cost of production on the Coast. This, of course, would reduce the possible output and make the project still more precarious.

Smelting Process. The size and type of smelting operation depends upon the size and the nature of the market. If there is a large enough outlet for pig-iron, the blast-furnace process will be used, because it is the standard, and, of course, the cheapest. The high cost of coke and the fact that the market for pig-iron extends over the vast area of the Pacific Coast States may make the cost of production of iron so large that the present margin due to the high cost of transportation will be eliminated.

Statements have been made by engineers that pig-iron can be made as cheaply on this Coast as in the East. C. C. Jones of Los Angeles showed by calculation that this could be done by bringing coke into southern California from Utah. Others have suggested that this could be done in a plant in the Puget Sound region using Pierce County coke. The determination of the cost of production is a difficult problem. It can be done best by experimentation. This would be costly and should be attempted only by those with the true pioneering spirit and with sufficient financial backing to be able to withstand great losses. In the beginning, costs of operation will be high, and unforeseen difficulties will arise. Absence of profit during the early days of operation must be anticipated. The most advantageous site for the plant is in the Puget Sound district.

Electric smelting has been suggested as a substitute for the blast-furnace for the following reasons: (1) Good coke is not essential and the quantity of fuel needed amounts to only one-third that needed in the blast-furnace; (2) small-scale production is possible; (3) there is cheap power, or at least cheap potential power along the Coast. Were all these reasons facts, electric smelting would be a possible substitute. But power is not cheap, at least from the standpoint of electric pig-iron, and will not be cheap for many years to come.

Another process has been proposed, a substitute for both the blast-furnace and the electric-furnace processes and a sort of combination of the two. It is the preparation and melting of sponge-iron. Briefly, the process consists of grinding and purifying the ore by magnetic concentration, mixing it with a low-grade fuel, heating for two or three hours at a temperature of about 950°C., cooling, and passing the mixture through a magnetic separator. Metallic iron in a very finely divided condition, free from impurities, is obtained in the concentrate. This product is called sponge-iron. It is then melted in the presence of carbon in an electric furnace, by which means various grades of iron and steel can be made at will. From a theoretical standpoint, this process has some promise. It will utilize fuel of poor quality and can be used with impure ores. The fact that various grades of iron and steel can be made makes it adaptable to the conditions existing on the Pacific Coast. For example, to large centres that have near them deposits of iron ore and cheap fuel and that consume both foundry iron and steel ingots, this process would be peculiarly adapted. Sufficient experimentation has not been done to point to either success or failure.

Conclusion. The establishment of an iron and steel industry must not be undertaken without due consideration of all the relating factors. We need cheaper iron and steel; we have the raw materials at hand; we have only to determine the cost of production. The cost of production will depend upon the cost of coke, the size of the market, and, hence, the size of the metallurgical operation. The size of the market will depend upon the cheapness of the pig-iron and upon the number of different steel products that can be made profitably in the rolling-mill. The presence of such an industry will stimulate the growth and development of the West. The determination of the cost of production can, and undoubtedly will, soon be made, but it must be done by a strong organization and one with a fund of advice, both technical and commercial.

DIVIDENDS FROM UTAH MINES DURING 1921

During the first six months of 1921, metal-mining companies in Utah distributed dividends to their stockholders as follows:

Chief Consolidated Mining Co.	$88,403
Grand Central Mining Co.	6,000
Gold Chain Mining Co.	10,000
Silver King Coalition Mines Co.	182,415
Tintic Standard Mining Co.	117,470
Utah Copper Co.	2,436,735
Total	$2,841,023

During the first six months of 1920, ten metal-mining companies in Utah paid dividends totaling $5,754,071, and for the corresponding period in 1919, a total of $5,565,579 was disbursed. The dividend paid by the Silver King Coalition was the first in four years. The other disbursements, by the Chief Consolidated, Tintic Standard, and Utah Copper companies, all represent large decreases from former years.

SENATOR W. A. CLARK ON THE COPPER OUTLOOK

W. A. Clark, ex-Senator from Montana, is quoted as saying: "The copper market right now is about the flattest thing I know of, but it will not remain that way. As soon as things get straightened out in Germany there will be a big demand for copper all over Europe. We could sell copper now, but would not get the price of its production, and I will not sell it that way. Others feel the same, and we have formed a pool in this country of $40,000,000 to protect the interests of copper producers, who have something less than a billion pounds of it ready for the market. This does not mean, however, that the mines will remain shut-down until all of this is disposed of. Just as soon as there is a demand and the product starts to move, the mines and smelters will begin active work again. I imagine it will be nearly a year before things get to going full-blast again".

CURRENT OPERATIONS OF THE A. S. & R. CO.

The American Smelting & Refining Co. has cut it operations to approximately 40% of normal. Notwithstanding the general curtailment in copper production, this company has closed but two of its copper smelters, the others operating at part capacity. The lead-plants are doing relatively better. From its own ores the smelting company is producing about 3000 tons per month, as against a normal of between 6000 and 7000 tons. In addition, it has been treating toll ores from other properties, some being regular shippers, while others have switched their product to the Guggenheims because of the shut-down of other plants.

The smelting company has succeeded in disposing of all its own 1921 copper since the first of the year, at which time it abandoned its selling agency. It has on hand, however, a substantial quantity of the metal which was brought forward from 1920 and which represents the unsold accumulation of the former agency. Two Mexican smelters have closed down, the others working part capacity on copper and silver-lead ores. The El Paso copper smelter has gone cold, but the lead-furnace remains in operation. The Hayden smelter, handling Ray Consolidated concentrate, has also closed. The big Garfield smelter, however, continues to run, partly on Utah concentrates which have not yet been cleaned up, and to some extent on ores shipped from California, principally concentrate from the Engels mine. The Tacoma refinery has sufficient material from Kenecott, Beatson, and Britannia ores and from South American blister to keep it going at part capacity. The Perth Amboy copper smelter and refinery have been closed for some months, but the plant still operates on tin concentrates. The Baltimore refinery handles whatever copper comes to the East for treatment, while the rolling-mill department has continued operations at about 40% capacity.

WARRANT ISSUED FOR ARREST OF GEORGE GRAHAM RICE, PROMOTER OF BINGHAM GALENA COMPANY IN UTAH

George Graham Rice, alias Jacob S. Herzig, whose name has been mentioned many times in connection with stock promotions in various parts of the country, was one of the group for whom warrants were sworn out in Oakland, on July 8, on the charge of violating the Corporate Securities Act of California. A warrant also was issued for John Doe, an unknown employee of Child, Barclay & Co., and a third warrant was issued for that company, a firm of stockbrokers in Salt Lake City.

A circular letter sent out by Child, Barclay & Co. is quoted as saying:

"We have been requested by George Graham Rice, now sojourning in Salt Lake, to place your name on our mailing list to receive from us a copy of the forthcoming issue of our weekly market-letter, which will contain an analysis of the merits of the Bingham Galena Mining Co. stock. We shall be glad to send you an early copy.

"Mr. Rice asks us to say that he believes an investment made in Bingham Galena stock at this time will, in all probability, make up any loss which you may have incurred in Broken Hills stock. The Broken Hills situation is so discouraging that he is unable to hold out any hopes to you of an early improvement in the market price of that stock, and he feels that he owes it to you to put you in immediate touch with the situation in Bingham Galena stock. He is anxious that you make up your loss as quickly as possible. Mr. Rice is behind the Bingham Galena company and we need hardly acquaint you with his constructive methods. Mr. Rice asks us to say that he believes the stock will enjoy a quick rise to well above 75c. per share and will later sell as very much higher figures. We invite your business in the stock and would be glad to hear from you without delay."

At the close of business on July 7, the stock in Salt Lake City had been pushed up to a price of 38c. per share, but on receipt of the news of a warrant for Rice's arrest on July 8, the stock broke to 17½c. per share.

E. C. Bellows, Commissioner of Corporations for California, is quoted as saying:

"The notorious George Graham Rice is once more at his

old tricks, and is reaching after gullible investors in California by unlawfully offering the Bingham Galena Mining Co. stock for sale through circular letters to unsuspecting dupes in this State. Assisted by the postal authorities, I hope to be able to extradite this public plunderer and bring him back from Utah to answer to the charge of violating the blue-sky law by offering stock for sale without a license."

CANADIAN COPPER PRODUCTION IS 52% OF 'NORMAL'

The slump in the market quotations for copper has affected Canadian production less than it has that of the United States. Today the Canadian production is 52% that of the 1920 total at the corresponding time, while the output of the United States is figured at 20% that of 1920. In 1920 the United States produced 36,000,000 lb. of copper monthly while Canada produced 4,600,000 lb. Practically the whole of the Canadian production came from British Columbia, the output of Ontario being confined to that obtained as a by-product from nickel ores. The Granby Consolidated Mining & Smelting Co. is reported to have had the biggest month of its history in point of production in May. The output ran to 91,000 lb. The recent fall in the market, following signs of a rally, has again started speculation as to the immediate future of the industry in this Province. It is possible that a further decline of a point or two would mean the closing down of the Anyox plant although it is explained by the management that this would be done as a last resort. There are 1150 men employed at the smelter centre at present and a considerable number at the Cassidy (Vancouver Island) Collieries which are operated by the same company and from which coal is secured for industrial uses at Anyox.

ARIZONA'S MINES ARE APPRAISED AT $400,000,000

Producing mines in the State of Arizona are valued at $413,082,735, or 9% less than a year ago, in a report just made public by the State Tax Commission. The valuation placed on producing mines in 1920 was $453,094,846.26. "In view of the times, we consider a loss of only 9% a good showing," declared Charles R. Howe, chairman of the Commission. He said that the total assessment on mines will be more than one-half of the assessment on all property in the State.

The valuation of non-producing mines will be fixed by county assessors, but today it was estimated that this sum would be aproximately $10,000,000. Last year the valuation placed on non-producing mines was $8,786,621.26. According to the Commission, only seven counties in the State have producing mines at the present time. Gila county leads in the valuation of its active mines, which are put at $115,478,479. The other counties and the valuation put on the producing mines in each are as follows: Cochise, $105,771,621; Greenlee, $26,514,131; Mohave, $6,372,846; Pima, $23,348,756; Pinal, $46,972,546; and Yavapai, $88,624,356.

ARIZONA

Gleeson.—The Black Hawk Copper Co. has been organized by J. E. Pemberthy, and others, for the purpose of developing the Pemberthy group of claims in this district. Work will be commenced at once.

Kingman.—An increased scale of operation is planned at the C. O. D. mine owned by Morris P. Dudley and associates. The mill is handling 100 tons of ore per day and the company is shipping $40,000 worth of concentrate per month. It is expected to increase the capacity to 150 tons. A double-compartment vertical shaft is being sunk 300 ft. north of the present incline shaft.

Following the resumption of milling operations at the Dean mine comes the announcement of the discovery of a new shoot of high-grade gold-silver ore in a raise from the lower tunnel. The ore carries 80 oz. of silver and $16 in gold per ton, with the indications favorable for the continuation of the shoot to surface, a distance of approximately 200 ft. The reconstructed mill is supplied with oil-flotation units and is handling 50 tons of ore per day. W. W. Elliot, mill superintendent, expects to have the plant working at 60 tons daily capacity within a short time.

The Silver Trails Mines Co., owner of the Diamond Joe mine, has purchased the milling plant formerly operated under lease. It is to be remodeled and enlarged to meet the requirements of the Diamond Joe mine. The remodeling plans include the construction of an aerial tram from the mine to the mill. A generous tonnage of oxidized and sulphide ore stands in the underground workings awaiting reduction. In the upper levels the ore is almost entirely silver-bearing, but in the sulphide area, carries a gold content of $8 per ton in addition to average silver values of $15 per ton.

Miami.—The Miami Copper Co. has declared a dividend of 50c. per share for the quarter ended June 30, 1921, payable to stockholders of record at the close of business on August 1. The distribution will be made on August 15.

Oatman.—The United Eastern Mining Co. has declared a quarterly dividend of 15c. per share payable on July 28, to stockholders of record, at the close of business on July 8.

Patagonia.—Peter Hansen, who recently took an option and lease on the Rhea mine, three miles south-east of here, has moved the compressor from the Mansfield mine to his newly acquired property. Work is being done in the main shaft, which is 230 ft. deep. Hansen expects to ship lead-silver ore to the smelters within the next two months.——John C. Holmes, who is working a placer claim between Bloxton and the Three R mine, says that his property is in excellent shape. He believes that the placer grounds would prove more valuable if worked on an extensive scale by dredging.——Work is being rushed on concrete foundations at the Blue Nose mine of the Arizona-Patagonia Silver Mining Co. The new machinery has arrived at the mine.

CALIFORNIA

Angels Camp.—Fire of unknown origin destroyed the entire mine plant of the Sultana Mining Company on the night of July 5, the loss being estimated at between $75,000 and $100,000. The hoist, head-frame, compressor, and engine and boiler rooms, with all their equipment; the transformer house, blacksmith shop, change-house, oil-plant, and storeroom full of supplies, went up in smoke. The mill was 500 yards distant and escaped. The mine, formerly known as the Bovee, had an enviable record years ago. The property adjoins the Angels mine on the north; the shaft is 800 ft. deep.

Auburn.—The mining property owned by S. J. Caples has been taken over, under bond and lease, by James D. Stewart, and associates. Drifting into the old gravel channel has been started under the direction of F. A. Moss, superintendent. The property is located in the Last Chance mining district.

Bridgeport.—William Sanger is reported to have found a vein of rich silver ore at a place called Cow Camp in the Silver Creek range. The ore was found in a 90-ft. shaft.——A bed of rich gravel has been uncovered in Dog Creek canyon by J. N. Beck, H. G. Beck, and associates. After a period of profitable operation, the placers were abandoned years ago when a layer of lava was encountered. Working on the theory that this cap was not thick the present operators dug through it and discovered a channel of rich gravel. A large number of claims were staked and C. B. McColm is said to be financing the work of hydraulicing the deposits.

Grass Valley.—A tentative agreement to arbitrate has

been entered into between the Mine Workers' Protective League, whose members are on a strike over wage conditions, and the Empire mine management, representatives of both sides announced on July 9. An order by the League to withdraw the pump-men from the Empire mine has been suspended for a week. In other mines the pumps are being operated by crews brought here from outside points.

Approximately 600 miners have been absent from their places in the local mines since July 1, when they refused to return to work at the new wage-scale announced by the operators during June. The operators published a statement early in June that when the old wage agreement expired on July 1 wages would be reduced $1 per day.

The miners' organization submitted a proposal to the operators that the pay be cut only 50c. per day, but the operators were insistent that the reduction be $1, making $4.62 per day for miners and $4.25 for shovelers.

The Alta Combination Mines Co. is engaged in driving an air-shaft, from the 500-ft. point in its adit, to the surface. The company is searching for the Alta Hill gravel channel which it expects to tap by means of the extension of the tunnel.

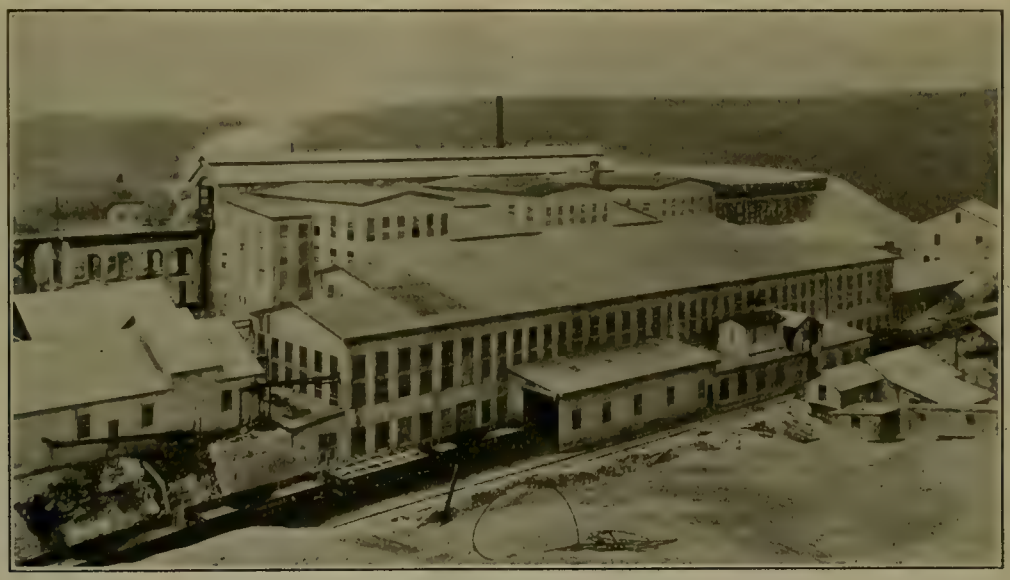
Jackson.—The Crocker company is engaged in preliminary work for the exploitation of the Elephant Deep gravel mine. The old Volcano ditch that was used 40 years ago will be cleaned out to provide water for the project. This ditch is 28 miles long.

Kennett.—The United States Smelting, Refining & Mining Co. has petitioned the supervisors of Shasta county to reduce the assessment on its property from $1,015,210 to $230,371, the former figure being the valuation determined by the county assessor.

The company holds that because the price of copper has fallen from 18.5c. to 12c. in the last twelve months, its smelter and mining machinery in Shasta county are worth only what they will bring as junk. A year ago there were 119,322 tons of copper ore blocked-out in the Mammoth mine, but this could not be worked during the year except at great loss, and hence the mine and smelter have remained closed.

The Mammoth mine was assessed this year for $448,720 The company asks that this figure be cut to $39,391. It asks that its Sutro mine be reduced from $59,160 to $16,000, and its Keystone group of mines from $32,000 to $13,200. The company owns fifty cottages in Kennett. They are assessed for $15,000, and it asks that the valuation be cut to $6720, as most of them are vacant. The smelter, machinery, bag-house, railroad, tramline, and other appurtenances of the smelter are assessed for $435,330. The company asks that the valuation be reduced to $141,780.

Redding.—The Mountain Copper Co. has petitioned the supervisors of Shasta county to reduce the assessed valuation of its property from $439,200 to $50,000. It is alleged that existing economic conditions are such that the company's mines have only a "speculative" value. It is claimed that $100,000 is a fair cash price and since the appraised value of property is approximately 50% of its true value, $50,000 should be a fair assessment. The company has commenced work on the construction of an aerial tram from the Hornet mine to connect with the Southern Pacific railway at a point three miles east.



No. 3 Mill of the St. Joseph Lead Co., at Elvino, Missouri

COLORADO

Aspen.—Samples taken from the raise in the Hope tunnel, have shown a silver content of from 87 to 100 oz.; ore is piling up at the portal for later shipment.——John Cortellini of Leadville and associates are pushing development in the Park tunnel. An aerial tram for transportation of the ore is under construction.——The Midland tunnel is being extended to cut workings of the Midnight mine at depth.——A good grade of silver-lead ore is being saved for shipment by the Aspen-Silver-Lead Mines Co., of which J. J. Yeckel is manager.——Lessees on the Little Annie report cutting what is believed to be the apex of a rich shoot. The property is operated by the Richmond Hill company.

Cripple Creek.—Persistence of rich ore at great depth in the mines of the Cripple Creek district is evidenced by developments in progress at the Portland, Vindicator, and Cresson mines. At the Portland No. 2 shaft the orebody at the 24th level has been opened by drifts north and south of No. 2 shaft, 240 ft, north and 170 south. Ore in the north drift has been uniformly of smelting grade. Seventy feet of the south drift has been high-grade, the remainder mill-grade. On the 1500-ft. level the Lee shoot has recently been opened with rich ore appearing. The 12th-

level shoot was 70 ft. long; whereas the newer shoot is not yet proven.

At the Vindicator the new shoot opened up at 2000 ft. (Golden Cycle 19th level) is the extension of the Lillie shoot opened last year on the Vindicator 19. The new orebody, carrying "a very good grade of ore", according to George Stahl, manager, has been proven 300 ft. in length, and due to its sharp dip will afford around 200 ft. of stoping ground. The shoot extends within the area where the 20th-level station will be cut preparatory to raising the shaft through to connect.

The Cresson ore is being broken with machine-drills in stopes from 125 ft. to 150 ft. wide. This is in virgin territory, north, between the 1100- and 1200-ft. levels. This huge orebody is making 90% ore with but the coarsest sorting; the average assays are from $12 to $15 per ton. Many cars have returned one ounce gold per ton.

Georgetown.—The Mendota shaft has been unwatered by the Wasatch management and operations resumed underground.——E. E. Bush, with California backing, is operating the O'Connell property in West Argentine.——Operations are to be resumed by W. H. Barber of Denver on the Barber group at Empire.——At Apex the Saco de Oro company has opened a vein, new to the property, sampling close to four ounces gold per ton. The tunnel is projected to cut the Rochester vein that produced rich silver-lead ore from the Rochester shaft-workings before water brought a sudden termination to operations.

Kokomo.—Ore-bins at the Silver Queen mine of the Kokomo-Recen Mining Co. are full and awaiting cars for shipment of silver ore to the A. V. Smelter at Leadville.——The Kokomo Mining Co. continues development of the Pearl Consolidated group on Chalk mountain and is saving ore for shipment.

Ouray.—The capacity of the Mountain Top mill is to be increased 100%; the equipment is being delivered.——The Union Mining & Milling Co. has obtained transformers and other equipment saved from the Gold Crown mill, when the plant was destroyed by fire, and with new machinery is equipping the Union mill.——The working force at the White Cloud-Paymaster mines is to be increased as soon as a compressor is installed; machine-drills will then replace hand-steel. A mill is being considered.

IDAHO

Coeur d'Alene.—Work on the tram at the Sidney mine is almost completed and shipments to the Bunker Hill smelter will soon be made from the stock of carbonate ore opened in the surface workings while tracing the vein along the hillside. The lower cross-cut tunnel is to be extended.——The new 50-ton concentrator at the property of the Sunshine Mining Co. on Big creek is rapidly nearing completion. The plant will be in operation within the next 60 days.——Reports from the Sterling Silver Mountain property, situated near the Yankee Boy group on Big Creek, state that the lower cross-cut adit has been advanced nearly 600 ft. and is now within 200 ft. of the main vein which has been opened by surface workings and by means of an upper adit from which good silver ore was obtained. The present cross-cut will reach the vein at a depth of 500 ft., while a drift into the hill will add an additional 500 ft. when vertically beneath the outcrop.

Development work at the Liston property, now known as the First National group, will include a cross-cut to the vein and drifting to a point beneath the No. 2 tunnel, where a body of ore was exposed. The property is well equipped with machinery for rapid and economical work.——The Coeur d'Alene Syndicate Co., owning a group of claims near the west fork of Big Creek, has a crew of men at work driving a cross-cut adit.——On the west fork of Big creek the Hartford group, the Silver Dale, and Big Hill are all being actively developed.

A shoot of rich lead-silver-zinc ore, more than 100 ft. long, with some of the clean ore reported to run 60 and 70 oz. in silver is reported in the old Sisters mine. Five carloads already have been shipped to the smelter, returning 33 oz. silver, 32% lead, and 16% zinc. Dan Murphy, superintendent of the Tamarack & Custer mine, is president of the Sisters Leasing Co. that is operating the mine.

Rush J. White has taken a bond on the Argentine property and has sublet his bond and lease to skilled miners who are working under his direction in an attempt to find ore. The ore is one that is particularly desired by smelters for its fluxing qualities. High-grade silver ore was mined 20 years ago.

The Callahan Zinc Lead Co. is actively developing its mine during the period of suspended production. The main three-compartment shaft has been sunk another 200 ft. from No. 10 to No. 11 level; drifting on this lower level has now been started. The work in progress at this point will open the orebodies at a point 1450 ft. below No. 4, or main-tunnel level.

Lakeview.—A geological survey of the area adjacent to the south half of Lake Pend Oreille, including the mining districts of Lakeview, Blacktail, and Granite creek, will be conducted this summer as one of seven projects undertaken by the State Bureau of Mines in co-operation with the U. S. Geological Survey. The area is one of considerable promise; small bodies of silver ore, accompanied by lead and zinc have already been found. The work will be in charge of the U. S. Geological Survey, under general supervision of F. B. Laney, head of the department of geology of the University of Idaho.

MICHIGAN

Houghton.—Beginning July 1, the Quincy Mining Co. lowered wages about 6%, making miners' wages $3.15 per day and trammers' $2.80. The new scale is about equal to that paid by Copper Range and the other operating mines of the district. There is no change in operating conditions at Quincy. The mine is working 4½ days each week with a minimum force. Production is understood to be about 1,000,000 lb. per month.

Sinking is under way in the Champion No. 1 shaft, in Trimountain No. 2 and No. 4, and in Baltic No. 2. Sinking in No. 3, Baltic, is about to start. Copper Range is well opened ahead and will be in a position to bring production up to a miximum when metal market conditions permit. No construction work of any extensive character is under way and no changes are being made in the milling plants.

Copper Range costs from this time on should show a considerable reduction. Wages are down to a pre-war level and the company is now operating with a new supply of coal which cost approximately half the price of that shipped in last summer. Coal is still 100% higher than in the pre-war normal years, but the saving effected will be large nevertheless. Nearly all of the old supply was used up early in June. Freight-rates have served to keep up the price on coal. Copper Range was fortunate, however, in being able to take advantage of the reduced lake freight-rate on coal.

A total of 5,858,000 lb. of copper was shipped out of the Lake Superior district by boat in the month of June. It is estimated that 1,000,000 lb. more, in the form of ingots, bars, and wire, went out by rail. Production for the month, including Copper Range, Mohawk, Wolverine, Quincy, and the Calumet & Hecla refinery output, was $5,500,000 lb. Although metal sales fell off sharply the last ten days of June, the shipment figures indicate fairly large sales for the month as a whole. Of the water shipments, Calumet & Hecla sent 1,500,000 lb. to Germany and Copper Range, 700,000. The remainder was for domestic consumers. The

shipments by boat showed a considerable increase over those of May and those of June a year ago. In May the total was 5,310,000 lb. and in June of last year, 5,190,000.

According to advices from Detroit, many former residents of this district now in that city will return here when mining operations are resumed at properties now idle. A large number of these men are either out of work or dissatisfied with their present employment. One man writes: "If copper comes back next fall, or early in the spring, you'll see hundreds from this and other southern peninsula cities striking out for the Copper Country".

MINNESOTA

Duluth.—Shipments of ore from the head of the Lakes for this season to date total less than half what they were during the same period last year. In fact, shipments for June a year ago were greater than for the entire season thus far, the total this year being 6,107,479 tons, against 7,533,824 tons in the single month of June 1920.

On the Talkeetna River in Alaska

MONTANA

Butte.—At the North Butte property, 70 men are employed. Drifting is being done on the lower levels of the mine and sundry raises are being completed. Work, however, is largely confined to keeping the mine in repair.—— Development work is proceeding in the Butte and Plutas mine. It is reported that 2½ ft. of good silver ore has been uncovered in the Norwich vein on the 40-ft. level.

The East Butte smelter in June produced less copper than in the previous month. The May production was 1,726,000 lb., due to a clean-up of ore on hand, the large furnace operating that month instead of the small one. June output was approximately 1,000,000 lb., of which 50% is East Butte's own production, the remainder representing custom ore, largely Davis-Daly's. The East Butte company has made money in every month this year, so it can be appreciated to just what extent costs have been reduced from the 15.25c. average of 1920, and the high average of 16.58c. in 1919.

Fort Benton.—The suit of Oscar B. Goom, who alleged that his livestock had died as a result of inhaling gases and fumes from the Great Falls smelter of the Anaconda Copper Co., will be re-tried, as a result of the failure of the jury that heard the case to reach a verdict. The trial of the recent suit consumed four weeks during which 150 witnesses were examined.

Victor.—W. R. Price, of Helena, acting for Eastern capitalists, has obtained control of the Curlew mines, the sale price being reported as $125,000. The mine was once a well known silver producer and is credited with dividends of approximately $1,000,000.——A new company is being formed to take over the Liverpool mine, another old silver producer; $250,000 worth of silver ore was shipped from the mine during the most recent operations which ended with a shut-down about three months ago.

NEVADA

Divide.—The assets of the Victory Divide have been conveyed to the Reorganized Victory Divide Mining Co., which is assessable, and assessment No. 1, for 1c. per share, has been levied. A report by A. I. D'Arcy, president and general manager, says: "The mine is being developed by means of a two-compartment vertical shaft to a depth of 200 ft., and by means of an inclined winze on the vein to a depth of 500 ft. below the surface. Levels have been driven at the 200-, 250-, 310-, 360-, and 500-ft. points, totaling over 2000 ft. Just east of the shaft on the 200-ft. level is disclosed a large north and south fault, which displaces the vein, and it is our intention to drive a cross-cut north-east-

erly to pick up the faulted segment of the vein east of the fault and toward the Brougher Divide".

Goldfield.—The Silver Pick has a stope 10 ft. high and 10 ft. long above the drift in which ore was found in the foot-wall of the Red Top vein at a depth of 265 ft. The average grade of ore broken from the drift and stope is $50 to $70, according to Ben Gill, secretary for the company.

Hornsilver.—J. W. Dunfee, lessee of the Orleans, has shipped three carloads of ore to the MacNamara mill at Tonopah. The first carload assayed $32, the second $49; the third has not been sampled. This ore is coming from the 580-ft. level and Dunfee is prepared to continue the shipments indefinitely. The shoot has been opened for a length of 120 ft. and a raise is now being driven. The vein has not been cross-cut. Both the MacNamara and Belmont mills are prepared to handle the ore, which is ideal for cyanidation.

Klondyke.—Five 6-ton trucks, owned by Charles Wittenberg, a Tonopah contractor, are being used to haul ore from the Klondyke district to the mills at Tonopah. There is estimated to be 2000 tons of ore broken in the various mines, with 10,000 standing in sight. There is estimated to be at least 1000 tons broken in the Knox and, since the ore-shoot has been found on the bottom levels, there is a huge tonnage standing. Recent developments in the Original Klondyke have caused the owners, E. Marks and Harry MacNamara, to raise the price at which they will sell from $40,000 to $100,000. Five large samples of several hundred tons of ore being shipped from the Maupin and Logan sub-lease on the Original Klondyke gave $48, $69, $33, $27.70, and $26. Strong and Darnell are shipping 100 tons of $50 ore from their sub-lease. The ore from both of these sub-leases is being sent to the Belmont mill. The finding of ore on the bottom level of the Knox is regarded as being of importance because it indicates that the shoot extends to great depth on the lime-rhyolite contact.

Lone Mountain.—The vertical shaft being sunk by the Electric Gold Mines is 130 ft. deep and it will be continued to 200 before lateral work is started. The shaft has passed out of the vein into the foot-wall.

Lovelock.—Mining activity is being resumed at the old mining camp of Rileyville on what is known as the Japanese property, southeast of Lovelock. Jones & Clark who operate the property, report uncovering a shoot of high-grade ore assaying close to $500 per ton, largely gold. The high-grade shoot is 12 ft. wide and 18 in. thick. The high cost of mining and transportation has delayed the operating of the property at full capacity but with the uncovering of the high-grade ore work will be resumed.

The Rochester Silver Corporation made its fortnightly shipment of bullion on July 7. The shipment is up to the regular average of $28,000 to $30.000. According to the management the underground conditions of the mine are still good with development work progressing at the rate of 750 ft. per month. The mill is operating at full capacity on the average tonnage held for the last two and a half years.

Mina.—The mill of the Simon Silver Lead Mines Co. is 90% complete. The company has negotiated a contract with the United States Smelting Co. to ship its lead concentrate to the smelter at Midvale. It is reported that the company has purchased the controlling interest in a smelting plant on the Californian coast in which it will treat its own zinc concentrates. The plan is to make zinc-oxide.

Montezuma.—The Harmill has started widening and retimbering the 100-ft. shaft on the claims bought from Moon and Whitaker. It is planned to sink the shaft to 300 ft. and extend the drifts on the 50- and 100-ft. levels, which are in ore.

Silver Peak.—The Sanger-Taylor property near here has been sold to the Natural Soda Products Co., controlled by the Wattersons of Inyo county, California. The Sanger-Taylor property is a silver prospect with an 80-ft. shaft.

Tonopah.—The discovery of 4 ft. of free-milling gold ore at the bottom of a 95-ft. prospect shaft on the property of the Electric Gold Mines Co., is reported. The mine is in the Weepah district, 30 miles south-west of here. The prospect shaft is near the foot-wall side of the main vein, which is known to be over 70 ft. wide, and opens richer ore than has heretofore been developed. One cross-cut disclosed ore assaying from $12 to $20 per ton for the full width of 70 ft. A new engine is being added to the plant to give increased compressor capacity for running hammer-drills.

The West End Consolidated Co. shipped 33 bars of bullion, weighing 66,000 oz., the first week of July. Including the gold content the estimated value is $72,000. The mine report says that raise No. 12, from the Ohio shaft, continues showing a full face of mill-ore.

It is reported that the second payment of $15,000, on the purchase price of the Clifford mine in the Stone Cabin district, has been received here. This payment makes a total of $22,500, leaving a balance of $77,500. The recent discovery of gold ore, assaying $150 per ton, has stimulated interest in this district where silver has hitherto been the most important metal.

UTAH

American Fork Canyon.—What appears to be the most important discovery made in this district during the past twenty years is the opening of 11 ft. of almost solid galena in the Echo claim of the Silver Wave group, according to C. B. Ferlin, manager for the American Leasing Co., which is operating the property under lease. The discovery was made in driving a tunnel from the Live Yankee mine. Twenty teams are employed by the company in transporting ore down the canyon and bringing supplies up to the properties. About 50,000 tons of mill-grade ore has been developed and a small concentrating plant is in operation.

C. W. Earl, superintendent of the Austin property, reports an important find in a 20-ft. raise from the Austin tunnel. An 18-in. vein of high-grade carbonate, with solid galena scattered through it, has been opened. In this same tunnel, about 75 ft. distant, gray-copper ore is being developed. An assay gave returns of 16 oz. silver and 16% copper.

Eureka.—In spite of decreased prices for lead and copper, the difficulty of marketing silicious ores and other vexations, the production of ore at the Tintic district for the first six months of 1921 totaled 3958 carloads, as compared with 3501 for the corresponding period of 1920. The increase was due principally to the large output of iron fluxing-ore at the Iron King mine and to the tonnage shipped by the Tintic Standard company to its new milling plant. The Tintic Standard was the largest shipper, its output being 1440 carloads, most of which went to the milling plant. The Chief Consolidated was second, with 894 carloads, and the Iron King third, with 339 carloads.

At the Eagle & Blue Bell and Victoria mines, both of which are being operated through the shaft of the former company, conditions continue to improve. There are now 125 men on the payroll, and during July this force will be increased to 150 men. Recently miners have been coming into this district from other camps. Four cars of ore per day are being shipped to the A. S. & R. Co., most of which is a silicious silver ore, the remainder being a high-grade lead product. At the Victoria mine the high-grade silver-lead ore found on the 1350-ft. level, then tapped on the 1450, has been reached with a drift on the 1500-ft. level.

Three shifts are now being employed by the Chief Consolidated Mining Co. in the sinking of the Water Lily shaft.

The shaft, having three compartments, has been equipped with modern hoisting machinery. Active development is planned.

An important discovery was made recently in the property of the Tintic Treasure Leasing & Mining Co., in the southern part of the district, according to J. S. Free, manager. The ore is in a fissure in the porphyry and has been developed for 33 ft. in length, with an average width of 2½ ft. Assay returns show 40 to 60 oz. silver and 20% lead. The orebody was opened at a point 185 ft. below the surface and 340 ft. from the portal of the adit.

Milford.—Operations have been resumed at the Bon Saldo Mining Co.'s property in the South Star district, according to George Miller, manager. The company has recently installed a gasoline hoist and a shaft has been sunk to a depth of 135 ft. The property adjoins the Moscow mine, once an important producer.

Moab.—A. W. Stevenson, president of the Pittsburgh Radium Co., operating claims in the Yellow Cat district, reports that a force of 18 men is at work. The company is building a reduction plant at Denver, which should be completed early in August. The principal product will be vanadium; it is said that the company has orders from Eastern steel-mills.

WASHINGTON

Springdale.—The Cleveland mine, 18 miles west of Springdale, resumed operations recently, after being closed down since last fall. The mine was once a producer; it is equipped with a concentrator and flotation plant. The chief metals are silver, lead, and zinc.——The Deer Trail mine in the same district is reported to be ready for operation, and the Queen and Seal has been shipping steadily for several weeks, loading a car of ore each week.

Spokane.—Members of the Columbia Section of the A. I. M. & M. E. will take an outing of three days, leaving Spokane August 21, for a visit into the east Kootenai mining district of British Columbia. The party will visit several camps, including the Sullivan mine where they will be entertained by engineers of the Consolidated Mining & Smelting Co. Arrangements have been made for transportation of about 50, including ladies.

BRITISH COLUMBIA

Grand Forks.—The Horn Silver mine has been acquired by Herbert Powell. Shipments have been made this year to the Trail smelter. It is said that Powell will endeavor to interest capital with a view to the installation of a small reduction plant.

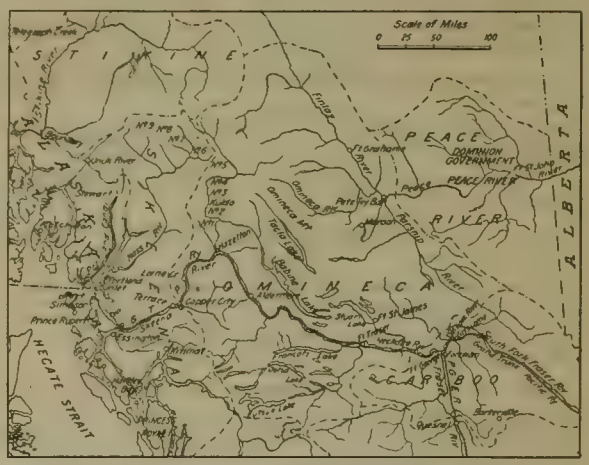
Nelson.—The difficulty of identifying mineral ground held by Crown Grant and otherwise in some of the districts of British Columbia was discussed recently by the B. C. Prospectors' Association. Considerable areas, it was contended, should be re-surveyed, permanent location posts planted, and maps prepared on a scale of 1500 ft. to the inch showing all important rivers, creeks, and other topographic features mentioned in the original field notes. It is argued that forest fires, and the natural destructive agencies of nature have obliterated old land-marks.

Prince George.—The North Point Mining Co. is developing a promising silver-lead-gold property situated near Hudson Spur on the Fraser river and near the Grand Trunk Pacific Railway. Recent work is reported to have cut an 8-ft. vein showing good assays. The main adit now in 350 ft. is expected to strike the principal vein at about 600 feet.

Revelstoke.—Frederick Keffer, of Spokane, is making an examination of the Lardeau district in the interest of Spokane capitalists, who, if the examination is favorable, contemplate operating a dredge in the district.

Trail.—The smelter receipts for the third week in June totalled 6476 tons. The Florence mine, at Ainsworth, contributed 102 tons; Knob Hill, Republic, 50; Surprise, Republic, 37; and the Consolidated company's mines, 6237. ——The abandonment of its Red Mountain branch by the Great Northern Railway Co. will leave the Josie and Velvet mines, at Rossland, without transportation facilities. More than a million dollars has been spent on the development and equipment of these mines. The owners of the Josie were about to erect a concentrating plant, and improvements had been planned for the Velvet, a strong company recently having been formed for the purpose. The Great Northern company claims that the line has been operated at a loss for some time, and no other course was open to the company.

Victoria.—The Provincial Department of Mines has issued the annual report for the year ended December 31, 1920. The final figures of the value of production come within $50,000 of the estimate made by the Provincial Mineralogist at the commencement of the year, but some of the individual items vary vastly from the early estimate. Thus, for example, as your correspondent suggested at the time, the figures for the zinc production were altogether too high in the preliminary estimate, being some 29 million pounds in excess of the actual production. On the other hand, the figures for the lead production were some 18 million pounds too low, and were the means of doing much to counteract the error made in the zinc production. The following are the final figures, those of 1919 being given for comparison:



Part of British Columbia

	1919		1920	
	Quantity	Value	Quantity	Value
Placer gold, oz.	14,325	$286,500	11,080	$221,600
Lode gold, oz.	152,426	3,150,645	120,048	2,481,392
Silver, oz.	3,403,199	3,592,673	3,377,849	3,235,980
Copper, lb.	42,459,339	7,939,896	44,887,676	7,832,899
Lead, lb.	29,475,968	1,526,855	39,331,218	2,816,115
Zinc, lb.	56,737,651	3,540,429	47,208,268	3,077,979
Coal, long tons	2,267,541	11,337,705	2,595,125	12,975,625
Coke, long tons	91,138	637,966	67,792	474,544
Miscellaneous products		1,283,644		2,426,950
		$33,296,313		$35,543,084

MEXICO

Choix.—It is reported that the Lluvia de Oro Gold Mining Co. has nearly exhausted the present ore-reserves and will not undertake further development of the property at the present time.

YUKON

Dawson.—G. P. Mackenzie, Gold Commissioner for the Yukon, has been made a land commissioner for the Northwest Territories, in order that claims staked in the Fort Norman oilfield by Yukoners may be recorded at Dawson, thus avoiding a trip to Edmonton for the purpose.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

E. B. Rider is at Bisbee, Arizona.

A. G. MacGregor has returned from Peru.

M. A. Newman is at Los Angeles, California.

D. O. Lima is now at Minneapolis, Minnesota.

A. B. Shutts is now at Pittstown, Pennsylvania.

Gilbert Hart is residing at Haileyville, Oklahoma.

Henry F. Collins has returned to London from Spain.

Lewis L. Bradbury is on his way from Los Angeles to London.

Thomas H. Sheldon, formerly of Denver, is at San Martin, California.

Charles Butters is not expected home from Nicaragua until September.

Fred Searls, Jr., on his return hither from China, went to New York.

A. P. Mallon is with the Dean Mines company, at Kingman, Arizona.

J. N. Justice has returned to England from Demarara, British Guiana.

Paul R. Cook has returned from the Near East and is now at Rolla, Missouri.

John Hays Hammond was in San Francisco this week, on his way to the Orient.

E. R. Wolcott, of the Western Precipitation Co., Los Angeles, is in New York.

W. S. Stevens, of Chicago, expects to leave shortly for a two months trip to England.

Thomas P. Carr is now manager for the Cia. Minera Anglo-Hispana, at Leon, Spain.

L. S. Cates has returned to Salt Lake City, after a six weeks visit to Boston and New York.

C. F. Rand has been elected to honorary membership in the Iron & Steel Institute, of London.

A. K. Anderson is now with the Howrey Creek Mining Corporation, at Willisville, Ontario, Canada.

George C. Jones, general manager of the Minas del Tajo and other properties in Mexico, is at Palo Alto.

Norman C. Stines has been appointed receiver for the Alaska Mines Corporation and is now at Nome.

John B. Harper, of Jerome, Arizona, was in San Francisco recently on his way to Sonoma county, California.

Edward W. Packard, principal owner of the Gemini mine in the Tintic district, recently visited the property.

Algernon Del Mar has returned from Mexico to Los Angeles, where he expects to remain until the autumn.

C. W. Whitley, vice-president of the American Smelting & Refining Co., spent several days at the Tacoma plant of the company recently.

J. E. Scott, from India, is making a tour through the West, with a view to informing himself concerning American methods of leasing mineral land.

Percy E. Barbour, the assistant secretary of the American Institute of Mining & Metallurgical Engineers, who has been seriously ill, is reported to be convalescent.

Charles Janin, in his capacity as consulting engineer to the U. S. Bureau of Mines, will make a study of cold-water thawing as used in alluvial mining in Alaska.

A. L. Feild, formerly assistant metallurgist at the Pittsburgh station of the U. S. Bureau of Mines, is now with the Union Carbide & Carbon Corporation, Long Island City, New York.

H. G. McClain and **Webster P. Cary** are now in partnership as McClain & Cary, mining and metallurgical engineers, at 708 Harrison avenue, Leadville, Colorado.

D. Vogt, the retiring president of the British America Nickel Corporation, intends to leave shortly for Norway, to take charge of the company's affairs in Europe.

T. Skewes Saunders, for several years the general manager for the Dos Estrellas Mining Co., at El Oro, Mexico, has opened an office at 525 Edificio La Mutua, Mexico, D. F.

The **Hon. William Sloan,** Minister of Mines for British Columbia, has been granted two months sick leave and has retired to his hunting-lodge, at Horn Lake, north of Nanaimo.

C. E. Davies has accepted the appointment of managing editor of 'Mechanical Engineering', and the 'Engineering Index', the two publications of the American Society of Mechanical Engineers.

Frank G. Janney, general superintendent of mills for the Utah Copper Co., at Garfield, Utah, has resigned, effective July 1. He is now associated with the Stimpson Equipment Co., of Salt Lake City.

Paul Hillsdale, a well-known mining engineer of Utah and Colorado, was married on June 21, at Eureka, Utah, to Miss Maude Fitch, daughter of Walter Fitch, president of the Chief Consolidated Mining Company.

Robert W. Butler has been appointed manager for the Mine & Smelter Supply Co. at Salt Lake City, succeeding **W. R. Thurston,** who has accepted a position with the McIntosh-Seymour Corporation, of New York.

Ralph S. Baverstock, of Baverstock & Payne, Los Angeles, having returned from an examination trip to the Mt. Gleason mining district, has left for Mojave. **H. L. Payne,** of the same firm, has gone to Yuma and to the Dome district on mining business.

Charles Salter, works manager of the Straits Trading Co.'s tin smelter at Singapore, is making a tour of metallurgical and mining districts in this country. He spent several days in Utah recently. He will sail from New York on July 23 for Liverpool, on his way home.

C. Yale Pfoutz, of Salt Lake City, who has been metallurgical engineer with the Utah Copper Co. for a number of years, has accepted the position of Assistant Professor of Metallurgy at the Colorado School of Mines. He will take up his new duties on September 1.

W. A. Clark, president of the United Verde Copper Co. and the Ophir Hill Consolidated Mining Co., spent several days in Utah recently, visiting the property of the latter company. He will sail from San Francisco on August 2 for a vacation in Honolulu.

Obituary

William J. Richards was killed recently at the Monongahela mine at Crystal Falls, Michigan, as a result of an accident due to the overwinding of a cable.

John Gately May died recently at Denver, Colorado. He was born on April 24, 1880. After completing his junior year in the Fremont High School he took a mining engineering course at the Colorado School of Mines, at Golden, Colorado, graduating in 1901. He then spent three years in San Javier, Sonora, and Durango, Mexico, in professional work. After returning to the United States, he made his headquarters in Denver, where he continued his studies and research work, taking up civil and electrical engineering. He traveled extensively, visiting and studying various mining projects in Colorado, Wyoming, Nevada, California, and New Mexico. He was connected with a number of domestic and foreign mining corporations.

THE METAL MARKET

METAL PRICES

San Francisco, July 12

Aluminum-dust, cents per pound	75
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.00
Lead, pig, cents per pound	4.65
Platinum, pure, per ounce	$72
Platinum, 10% iridium, per ounce	$90
Quicksilver, per flask of 75 lb	$48
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9.00

EASTERN METAL MARKET

(By wire from New York)

July 11.—Copper is inactive and soft. Lead is quiet but firm. Zinc is dull and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
July 5	59.00	36.25	May 30	58.15	33.60
" 6	59.50	36.25	June 6	57.68	33.75
" 7	59.00	36.63	" 13	58.39	35.29
" 8	58.50	37.50	" 20	58.77	35.18
" 9	55.50	36.88	" 27	58.69	35.25
" 10 Sunday			July 4	58.90	35.33
" 11	....	37.00	" 11	58.30	36.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
July	5 12.62	May	30 13.25
"	6 12.62	June	6 13.08
"	7 12.62	"	13 12.91
"	8 12.62	"	20 12.85
"	9 12.62	"	27 12.68
"	10 Sunday	July	4 12.62
"	11	"	11 12.62

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
July	5 4.40	May	30 5.02
"	6 4.40	June	6 4.90
"	7 4.45	"	13 4.75
"	8 4.45	"	20 4.47
"	9 4.45	"	27 4.32
"	10 Sunday	July	4 4.43
"	11	"	11 4.43

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	69.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
July	5 4.75	May	30 5.25
"	6 4.75	June	6 5.17
"	7 4.75	"	13 4.98
"	8 4.75	"	20 4.95
"	9 4.75	"	27 4.88
"	10 Sunday	July	4 4.75
"	11	"	11 4.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.09	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
June	14 50.00	June	28 48.00
"	21 50.00	July	5 48.00
		"	12 48.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

WE CAN MAKE PROSPERITY

We have one hundred millions of people, the most resourceful and enterprising on earth. Not all of them are producers, but every living one of them is a consumer, says the 'Manufacturers Record'. They are accustomed to a high standard of living. They do not scrimp themselves in food, or clothes, or pleasure. They have no faith in the philisophy that man is put on earth to do without. They believe that it is high motive to have large desires and achieve in such a way as to be able to satisfy them.

There is nothing more foreign to the American disposition than a buyer's strike. Americans fail to buy primarily not because they are on strike, but because they are without the means to buy. There was sharp ruin and the shadow of impending disaster in the repeated warnings of Government officials last year that people cease from purchasing. It meant the beginning of a cycle of stagnation.

The economists said that the solution of the world's great problem was production and more production. All production has been cut to the minimum. There is hardly a basic commodity in the wide world whose production is not at the lowest. Be it steel or lumber or the things that grow out of the earth, there is underproduction in all alike. And this at a time when the world has four years of destruction to make good! This at a time when every factory in the world might run day and night for years before making up the deficiencies! Therein is tomorrow's sun. There are economic laws which are as sure and fixed in their working as the rising tide. The underproduction of today foretells the insatiable demand of tomorrow. Not only will the 100 millions of people in this country begin before long to meet their needs, but so will the millions abroad. And the first signs of the rising tide will bring so soon a sense of confidence that rising prices, like a healing flood, will stir to life every channel of trade.

None knows better that we do the tragic mistakes which have been made. We exposed them before they were made, but our voice of warning was as that of one crying in the wilderness. Those mistakes are now, at last, everywhere being recognized. The Government is reversing its credit policy, slowly but surely. Counterblasts to the devastating publicity put out from Washington last year are being issued. A new psychology is being built up—the psychology of faith and enterprise. No longer is Washington advising people not to buy. It is urging them to buy.

Men still go about their business, still eat, still sleep, still walk, still play, still love, still fight, still desire, still have ambition, still labor, still spend. There is nothing that can hold them back. Peoples that conquered the Hindenburg line and smiled through years of hell will not succumb and lie them down to die because depression in trade has swept like poison gas over the land. They who won the war can win the peace; they can and they will MAKE prosperity.

MONEY AND EXCHANGE

Foreign quotations on July 12 are as follows:

Sterling, dollars:	Cable	3.64¾
	Demand	3.65¾
Francs, cents:	Cable	7.90
	Demand	7.88
Lire, cents:	Demand	4.59
Marks, cents		1.36

Eastern Metal Market

New York, July 6.

The tariff, with its new duties, is the principal topic discussed in market circles in the absence of any activity. The new tariff carries proposed import duties on tin, lead, and zinc. There has been little change in prices, which are firm to higher.

Buying of copper is still very light; price-changes have been insignificant.

Selling of tin has been confined to one day with prices firm and steady.

The lead market is very quiet with prices decidedly steady.

Prices in the zinc market are slightly higher but buying is still confined to urgent needs which are small.

IRON AND STEEL

The reduction in prices of various steel products formerly made on July 5 by the Bethlehem Steel Co. have been met by such of the other producers as were not already selling at the new Bethlehem levels. The fact is, that, as to some products, the announcement merely recorded what the market already had done, says 'The Iron Age'.

For the six months ending June 30 the country's pig-iron output, exclusive of charcoal iron, was 9,428,000 tons, against 18,139,000 tons in the first half of 1920.

Opposition in the steel trade to the metal schedule of the new tariff bill centres on the manganese ore and ferro-manganese duties, which steel manufacturers consider far too high. There is also the anomaly that 20 units of manganese in spiegeleisen pay $1.25 duty, whereas 80 units in ferro-manganese pay $39.42, or at nearly an eight-fold rate. The general provision for American valuations would be of little help in keeping out European steel, since nearly all steel duties are specific and hence do not involve valuations.

COPPER

It is understood that the one or two small interests which were selling copper at the lowest prices, recently have either parted with all the metal they have or have withdrawn from the market. This has stiffened the market to some extent but prices for most of the business being done remain the same on the average as a week ago, namely, 12.87½c., delivered, or 12.62½c., New York, for July delivery. Some sales have probably been made under this level but it represents the general market. In any event, sales have not been heavy. Most, if not all, of the so-called large producers are still out of the market and quoting nothing less than 13 to 13.25c., delivered, for July. The Lake copper market is practically on the same level as the electrolytic.

TIN

The feature of the week has been the duty on pig-tin, proposed in the new tariff bill submitted to Congress last week. It carries a duty of 2c. per pound on pig-tin with tin ore admitted free. This contrasts with the request for 10c. per pound on pig-tin and 6c. per pound on tin contained in ores, which was fathered by important interests. The moderate duty, while not as acceptable as free tin which is the rule now, is a matter of satisfaction to importers in that it is so much less than seemed imminent at one time. The week has been a quiet one—almost stagnant except for one day; on July 1, about 300 to 400 tons was sold consisting of prompt shipment from England and of future shipment from the East at 29.25 to 29.37½c. This was bought by dealers largely. Prices have been firm to higher here and in London. Yesterday British prices were £4 to £5 per ton higher than a week ago with spot standard quoted at £172 5s., future standard at £174 5s., and spot Straits at £172 5s. per ton. The spot Straits market at New York has been between 29 and 30c. during the week, with the quotation yesterday at 29.87½c. The quantity of tin delivered into consumption during June was 1590 tons with the amount in stocks and landing at 2546 tons on June 30. Imports to July 1, this year, were 8918 tons against 27,743 tons to July 1, 1920, or only about one-third.

LEAD

The feature of this market is the fact that in this locality at least, no metal can be bought from any of the independent producers. The leading interest therefore has the market to itself at 4.40c., New York, which is also the quotation at St. Louis. Independents there, however, are selling around 4.25 to 4.35c. for delivery in Chicago and the West. Independents, if they quote at New York, are offering nothing less than 4.62½c. The new tariff proposes a duty of 2½c. per pound on pig-lead as against the ad valorem duty, now, of 2.25%. This is a decided advance for with lead selling at 4c., London, as today, this would mean a cost of 6½c., duty-paid, seaboard, as against 5c. now, freight not being considered, or being the same in both cases.

ZINC

Prices of prime Western for early delivery in wholesale lots are slightly higher at 4.35c., St. Louis, or 4.85c., New York, or 10 points above those ruling a week ago. This is due partly, it is said, to the proposed duty of about 2c. per pound, effective for the first year after it goes into effect, but probably the major factor in stiffening the market is the fact that no producer will sell under this level and that those who were willing have disappeared. Demand is still confined to small lots for immediate needs and it develops now and then that some consumers have large stocks and others have almost nothing. Some who had large stocks sold them at a loss some time ago and are buying only as their needs develop, usually at lower levels.

ANTIMONY

Wholesale lots for early delivery are quoted at 4.75c., New York, duty paid, with the market quiet. Jobbing lots are about ¼c. per pound higher.

ALUMINUM

The leading producer continues to quote wholesale lots for early delivery unchanged at 28c. f.o.b. producer's plant, while the same grade from foreign sources is obtainable at 22 to 23.50c., New York.

ORES

Tungsten: No change is recorded; the market is quiet. Quotations are nominal at $3 to $3.25 per unit for Chinese ores with Bolivian and other ores at $3.75 to $4 per unit.

Ferro-tungsten is unchanged at 48 to 50c. per pound of contained tungsten in lump form, guaranteed as to quality.

Molybdenum: The market is without feature with quotations nominal at 50c. per pound of MoS_2 in regular concentrate, usually 85%.

Manganese: There is no demand with quotations nominal at 22.50c. per unit for high-grade foreign ore. A duty of 1c. per unit is contained in the proposed new tariff bill.

Manganese-Iron Alloys: There is no activity in either ferro-manganese or spiegeleisen and prices are nominal, those for ferro-manganese being $75, seaboard, for the British alloy and $80, delivered, for the American. Prices for spiegeleisen are $30, furnace. A carload of ferro-manganese is reported sold at about $72.50, delivered, and there are inquiries for two 100-ton lots of spiegeleisen. The production of ferro-manganese in June, according to blast-furnace reports of 'The Iron Age', was only 4536 tons, or the lowest for any month on record. No spiegeleisen was made in June. The tariff on manganese ore and ferro-manganese is a topic of much interest, with various views depending on the person or company interested.

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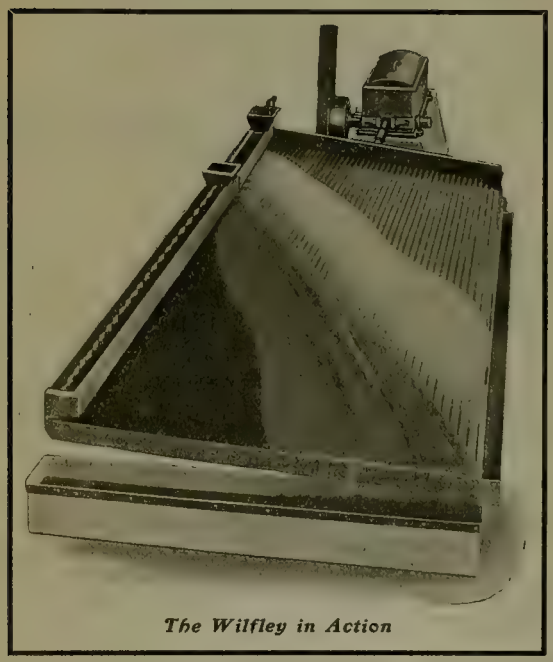

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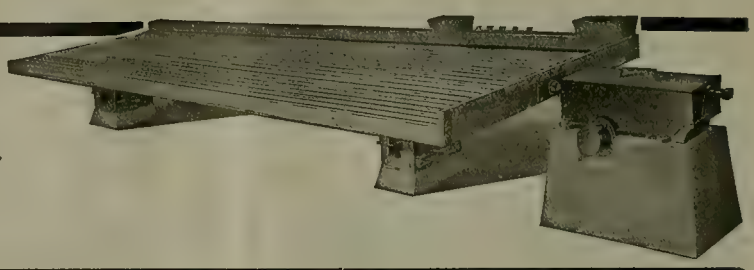

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T. A. RICKARD, - - - - Editor

PRESIDENT HARDING'S message on the Bonus Bill reminds us of the story of the Chinese cook and the tramp. The latter opened the kitchen-door and said, "I want something to eat". "You eatee flish?" asked the suave Chinaman. "Yes." "All lite, you come Fliday." Joking apart, the President has shown courage and good sense in opposing a gratuity of $500 to every service man, while at the same time emphasizing the need for concentrating any national benevolence upon those who are disabled or dependent. We hope that his wise action in this matter will serve to encourage efforts toward Federal economy in other directions.

ACCORDING to the 'Pioche Record', the 'Mining and Scientific Press' has "endorsed the new sensational bonanza silver camp" of Silverhorn, and to the Editor personally, as a "famous geologist and writer", is credited responsibility for this unqualified endorsement. All this appears in a telegram dated from New York as if to give it additional credence. The basis for these friendly exaggerations is an item that appeared in our news columns, for the accuracy of which the Editor is only indirectly responsible. We have correspondents in the various mining districts and they send us the sifted gossip of the camp; that, of course, is news, but it is a long way from being an expression of editorial opinion. We note that "a big interest" in the Silver Peer prospect has been sold to 'Tex' Rickard, so next the Editor will be credited with speculating on his own account, for the fight promoter has been identified more than once with him. Mr. George Lewis Rickard is a useful man in his day and generation, but we are not warranted in claiming any kinship, physical or mental, with him. As for Silverhorn, it is a promising district and we wish it good luck. That is all.

THE Commissioner of the U. S. Patent Office describes that institution as the largest 10-cent store in the world; for it sells weekly a vast number of specifications at that modest figure from its assorted stock of 75,000,000 copies. However, something more than financial success is needed, for the department is one of national importance. This being the case, it is all the more regrettable that conditions are such that a constant stream of its officials are 'seeking pastures new'. It is reported that over 100 examiners have resigned within twelve months, as well as nearly 150 of those in clerical posts. All appear to be poorly paid, 30 clerks receiving no more than $60 per month. The United Engineering Societies has issued a statement that draws attention to these wholesale resignations, and also to the fact that the Office is reaching a point of disorganization that threatens a crisis. Immediate legislation is necessary. The situation is described in this issue by Mr. K. P. McElroy, whose article we have re-printed from the columns of our contemporary, the 'Journal of Industrial and Engineering Chemistry'. As Mr. McElroy contends, a man of education and standing needs something more than salary to keep him in the job: he requires a certain amount of pride of place and dignity of position. If paid merely what he is worth and what he can command elsewhere, and if there are no other inducements, inertia is all that will hold him. The salaries paid in the Patent Office are too low, and there are no other inducements; hence the present chaos.

COLONEL GEORGE HARVEY must feel foolish when he meets veterans of the recent war or of other wars, of which there have been plenty during the last twenty years, for his military title is based upon service as a colonel and aide-de-camp on the staff of a Governor; indeed he must have been fond of the masquerade for, according to 'Who's Who', he has accepted that theatrical appointment four times, twice on the staff of a Governor of New Jersey and twice on the staff of a Governor of South Carolina. He is a clever man, why did he do it? Did it ensure him a railroad pass or sundry perquisites? Here we may note that both the 'New Republic' and the 'Weekly Review' write about 'Mr.' Smuts while they refer to 'Colonel' Harvey. It may not be surprising that a paper so ill-mannered and showing so little sense of humor as the 'New Republic' should make the blunder, but that self-appointed antidote to radicalism, the 'Weekly', ought to know better, for the South African statesman has been in command of armies in two great wars while Mr. Harvey was participating in the political vaudeville of two provincial Governors. Colonel House likewise obtained his military title by serving on the decorative staff of a Governor of Texas; he must have felt like a chump when asked when and where he had seen service as a soldier, particularly when he found himself in the presence of generals who were commanding the biggest armies that the world had ever seen in battle array. Surely it is time for an American

of distinction, notably an Ambassador, to drop these provincial trappings. 'Mr.' is a prefix good enough for the representative of our democratic Republic.

SUFFICIENT ore has been treated at the new plant of the Shasta Zinc & Copper Company at Winthrop, California, to prove the technical success and economic practicability of the process developed by the River Smelting & Refining Company at Florence, Colorado, for the smelting of the complex sulphide ore from the Bully Hill mine. The treatment of this ore has been for years the subject of investigation by numerous metallurgists, especially with respect to that class of ore in which the zinc content is high and the copper low; this naturally had been allowed to remain in the mine as long as profitable operation on ore richer in copper was possible. That now being smelted contains about 25% zinc and 2% copper, together with some gold and silver. It is crushed and roasted in McDougall furnaces preliminary to smelting in a reverberatory. The design and operation of the furnace differ in no essential particular from the ordinary copper reverberatory except that a combustion-chamber is provided for the oxidation of volatilized zinc as effected in the standard Wetherill furnace for the treatment of oxidized zinc ores. The copper carries the gold and silver into the matte. Exact analyses are not available, but we are informed on good authority that the matte is low in zinc and the slag reasonably low in both zinc and copper. The grade of the zinc oxide, collected in a bag-house of the usual type, is excellent; it is comparatively free of lead, and is contaminated with neither soot nor sulphates to an objectionable extent. The absence of lead makes it suitable for use in the automobile-tire industry, whereas freedom from discoloring matter fits it to serve in the manufacture of paint. Aside from the practical demonstration of the suitability of a reverberatory furnace for making zinc oxide, the success of the new plant is of interest because it may lead to the treatment of large quantities of complex ore elsewhere in California. Credit is due to Messrs. R. C. Beals, general superintendent, J. C. Kinnear, consulting engineer, and J. H. Rose, smelter superintendent.

IN this issue we publish a synopsis of the annual report of the Chile Copper Company, with interesting data concerning the year's operations at Chuquicamata, as well as the concluding article of a series on the enterprise, by our Mr. A. W. Allen, who visited the property last year. The two accounts, one official, and the other from a detached source, have much in agreement; Mr. Daniel Guggenheim makes no idle boast when he says, in the report, that the operations of the company "have now passed the development stage; the metallurgical predictions of your engineers have been met; your company has an extremely efficient staff of loyal and expert employees, and has arrived at a permanent stage of consistent and highly satisfactory operating results". The figures speak for themselves, and the policy of the company, in placing all technical information in the hands of those who are interested, is to be commended. Speaking of the financial future of this great enterprise, Mr. Guggenheim is optimistic. Holders of copper securities will soon be rewarded for their patience, he says. The lowest estimate, based on conditions as they exist at the present time, but not taking into consideration the large increase in the demand for copper that should come from Germany and the rest of the world, indicates that the consumption of copper is about 675,000 tons per annum, and the mine production about 375,000 tons per annum. At this ratio it is obvious that it will not take long to absorb the entire copper surplus. It is estimated that production is now about 30% of normal consumption, as based on pre-war statistics, plus the usual annual increase as in the past. The German plants that manufacture copper products are now re-established at full capacity. Raw material in quantity will be needed in Germany, so that the indemnity obligations can be met by the exportation of finished articles. In addition, the high price of coal, the relative cheapness of water-power, and the increased demands for such facilities as telephones and other electrical apparatus, will ensure a strong demand for the copper on which the electrical industry depends. We share Mr. Guggenheim's optimism, and believe that a revival in the industry is not far off.

'DISCUSSION' this week starts with a valuable analysis of the conditions governing the possible, or probable, establishment of an iron and steel industry on the Pacific Coast. The writer, Mr. Nicol Thompson, has made a special investigation of the subject and is thoroughly competent to discuss the matter authoritatively. Mr. R. H. Stretch, now residing at Seattle, is known to our readers as the author of that useful book on 'Prospecting, Locating, and Valuing Mines'. Recently when at Virginia City we saw his name on some old mine-maps, reminding us that he is a veteran indeed. We wish he could find time to record some of his experiences on the Comstock during the spacious times of the boom in the 'seventies. The new mining law as yet has not been received with favor by the prospectors who have written to us on the subject. Both Mr. W. W. Rush, of Kasaan, and Mr. L. I. Munson, of Republic, dislike sundry of its provisions. We shall be glad to hear from those who like the proposed revision; there must be many who favor it. Mr. Charles A. Bramble writes pleasantly, from Winnipeg, on the educating of an engineer, and gives the experience of his own life. Such testimony is valuable. We agree as to the basic value of mathematics as a training for the mental faculties. Mr. Bramble's Latin may have been scant, but it was enough evidently to help him in the use of our language, to which Latin has contributed so much, particularly for scientific usage. Our friend 'P. B.', as he is known to his acquaintances, writes from London in continuation of his little difference with our Mr. Allen. We agree that reviews should give the reader a fair and complete idea of the contents and character of a book, because, after all is said, the primary purpose of a review is to tell the reader whether

it will be worth his while to purchase it or obtain a copy at the nearest library. The last letter of 'Discussion' this week is particularly interesting because it is a legitimate and proper protest from a minority stockholder against laxity, if not impropriety, in the management of company affairs. With such protests, when honestly made, we have the utmost sympathy. Mr. Richardson is Professor of Latin in the University of California; he is one of our foremost educators, and a man widely known for his sagacity in such public affairs as come within his wide scope. In our issue of May 28 we published a letter from Mr. C. G. Fowler, in which a complaint similar to that of Professor Richardson was made against the Consolidated Gold Fields management of the American Trona Corporation. Mr. Fowler bought a large block of shares as a speculator. The Professor's interest is that of an investor, for he speaks in behalf of a holding of stock purchased by the late Warring Wilkinson, the father of Mrs. Richardson. We give these details so that the Gold Fields offices in London and New York will appreciate the good faith of his actions in this matter. Letters sent to them have not been answered. This is not only impolite, but stupid. Shareholders have the right to have reasonable questions answered, and, in any event, to have their letters acknowledged. This high and mighty way of treating minority shareholders is out of date, and it will do no good to the Consolidated Gold Fields if it expects to do business pleasantly in the United States. The Trona Corporation has been the victim of many blunders; of that there is no doubt; the least that those in control should do is to show some sense of decency in the treatment of bona-fide complaints.

The Tariff

In our issue of July 9 we summarized those provisions of the Fordney Tariff Bill that affect the mining industry. Naturally, any legislation that is beneficial to our clientele, the mining public, is agreeable to us, if it is not detrimental to the welfare of our country as a whole. That, of course, is not the sentiment that rules in Congress; in that gathering of Solons, as the daily press, unaware of the satire implied, calls our legislators, the framing of a tariff is chiefly a game of 'log-rolling', which is an arrangement between law-makers whereby groups trade their votes, so that, for example, the grower of almonds in California will support a duty on the pins made in Vermont, provided the Vermonter will vote for a duty on almonds, the net result being a duty on both pins and almonds, without regard to the welfare of the majority of our citizens not participating in the production of either pins or almonds. Forty years ago General Winfield Scott Hancock described the tariff as "a local issue", thereby raising a laugh that proved disastrous to his Presidential candidacy. Unfortunately, whatever the view of most people on the broad question of free trade versus protection, it is a fact that when a tariff bill is being framed its details are decided in accord with the desires and insistence of local industries and of special interests. This makes the whole question unsatisfactory and irritating, because it it so difficult to discuss it without prejudice. Even that excellent lady, Mrs. Robertson, the member from Oklahoma, stated that she would vote against a duty on hides because she cared more for the children, who use leather for shoes, than for the packers. There are more poor children than rich packers, seems to be her generous reasoning. Our own view is that we should protect young industries that would be killed by unrestricted foreign competition, in order that such industries, if essential to the country, may become firmly established and thereby contribute to making our country self-contained. During the War we found that for many essentials, such as dyes, potash, and antimony, we were dependent entirely upon importation. We proceeded to develop these industries in a hurry, and a good start had been made when the Armistice restored the *status quo ante,* thereby blighting the expectations of those who, in response to the national need, had started to make us independent of a foreign supply of these particular products. Most of us warmed to the idea of a self-contained country, that is, one which, if isolated in time of war, might be able to dispense with the importation of anything it needed for daily life and domestic industry—not luxuries or other non-essentials. That argument is being used in behalf of many of the metals and minerals mentioned in Mr. Fordney's bill. For instance, our production of tin is so small as to be negligible, yet the use of tin, for plating sheet-iron, is a matter of no small importance; so a duty on tin is advisable if it help to stimulate prospecting for tin ore, with a view to establishing a tin-mining industry that may make us independent of the Straits Settlements, the Malay States, and Bolivia. Antimony is another metal that we produce hardly at all; if a duty should serve to incite interest in the development of our own deposits of antimony, and if we have any large enough to supply the domestic demand, then in this case also an import duty might be advisable, not to enrich a small group in the community but for the benefit of the community as a whole. The war argument, however, breaks down when applied to the exploitation of known resources, for if the price of a metal or mineral be raised artificially by a tariff, it is obvious that the increase of price will hasten the exhaustion of the reserves during peace-time and, possibly, may cause the domestic supply to be depleted by the time we find ourselves again at war. It were better, from the point of view of the nation, to exhaust the resources of China or Brazil, in respect of a particular mineral, and to buy it cheaply from those countries during peace, than to pay high prices for the mineral and exhaust our own reserves, as against the time when those reserves may supply an urgent need. Such an argument is adverse to many of the duties suggested, but it supports the levy of a tariff on dyes and potash, for example, both being products of vast industrial importance that we ought to produce ourselves on a large scale. The granting of a duty on aniline dyes or on potash salts may benefit a small group, but that is not objectionable, pro-

vided it conduces to the welfare of the nation.

A few days ago we heard Mr. Adolph C. Miller, a director of the Federal Reserve Bank, speak in public on financial affairs in their broadest aspect. He had many wise things to say, particularly in emphasizing the fact that the present financial unpleasantness is due to the effort to readjust relations between the producing and the consuming capacities of different parts of the world. He adverted to the marked decrease in exports, which declined 55.9% in May as against the same month of last year. He recognized the truism that when your customer has to pay in cash, a rapid shrinkage of business with him is in sight. If, on the other hand, you buy from him he is enabled to establish a credit. The recent increase of half a billion dollars in the amount of gold held by the banks of the Federal Reserve system has caused some short-sighted publicists to chortle, whereas any sane economist sees that it is by no means a factor favorable to our foreign commerce or to our national welfare. When a fellow begins to pay for things with family plate or his wife's wedding ring, it augurs badly for further trade with him. That is Europe's status toward us. Apparently the gentlemen in Congress, and some outside, expect to export without importing; they expect to open up foreign markets while themselves sitting behind a Chinese Wall of tariffs; they count upon the prosperity of the United States while the rest of the world falls into the abyss. Yet Mr. Miller never mentioned the word 'tariff'. He feared to do so. Likewise, Mr. Hoover, one of whose recent public addresses we take pleasure in printing on pages 131 to 134 of this issue, makes a plea for a larger vision and an ampler perspective in world affairs, yet he also shies from any direct reference to the tariff, which is the negation of all the sane and generous ideas of men of his type. Of course, it is obvious, as many times before, that the arrangement of such a matter as the tariff should be based upon the recommendations of a non-partisan body of experts, such as exists in the form of the Tariff Commission; it should not be left to the mercy of a group of log-rolling legislators, in disregard of the recommendations of the Commission. The tariff is not economics; it is merely cheap politics.

Electricity and Copper

During the decade that ended with 1914, the electrical industry probably absorbed a half or slightly more of the world's supply of newly mined copper. Statistics are not in close agreement, but the available data make it certain that under normal conditions the use of copper for making electric conductors was by far the most important item in the gross consumption of the metal. The demand for brass during the War, coupled with the curtailment of sundry peace-time industrial activities, temporarily deflected the normal flow of metal from its accustomed channels. Following that came the period of obstruction and stagnation, with the consequent shutting-down of the copper mines. Unmistakable signs, however, point to the early disintegration of the restricting barriers; then it may be expected that the normal channels again will carry their share of metal into useful industries. Of these the creation, distribution, and utilization of electric energy should be the greatest; and as compared with former times the future requirements of the electrical industry should assume gigantic proportions. A few concrete examples may be cited to indicate quantitatively the importance of copper in the application of electricity. The San Joaquin Light & Power Company of California has just added to its 'connected load' some 46,000 horse-power; 2,000,000 pounds of new copper wire was required merely to connect the plants, factories, and homes of the new consumers to the distributing system that already was in existence. According to a survey made by the 'Journal of Electricity and Western Industry', there will be constructed during the next decade in eleven Western States new plants to generate 2,800,000 horse-power of electric energy; assuming the use of wire in the same proportion as in the work of the San Joaquin company, the final connections to be made would require about 280 million pounds of copper. A second important use of wire is in the manufacture of electrical equipment, including generators, motors, and switchboard appliances. High-tension transmission lines and the local distributing mains entail a still greater use of copper. The Pacific Gas & Electric Company is about to commence the construction of a double-circuit transmission line, 172 miles long, to connect the new hydro-electric plants of the Pit River project, in the Sierra, to a new sub-station at Vacaville. The current will travel over six stranded rope-lay cables, each with a capacity of 500,000 circular mills, which makes them approximately one inch in diameter; the line is designed to transmit ultimately 320,000 kilowatts at 220,000 volts. The power company has recently purchased from the Anaconda Mining Company 10,000,000 pounds of copper wire, three-fourths of which will go into this single high-tension line. Three features of plans for up-to-date electric-power enterprises enhance the importance of long transmission lines as a factor in consuming copper. These are (1) the general development of hydro-electric power projects. The source of the water-power, and consequently the site of the generating plant, is usually far distant from the region where the electric current is consumed. (2) The tendency to erect large coal-fired steam-electric plants at the mine, to take the place of great numbers of small generating units situated at the immediate point of consumption. (3) The growing acceptance on the part of capitalists of the fact, always appreciated by engineers, that efficient utilization of power resources depends upon the replacement of steam in plant and factory by electricity, and the inter-connection of generating units to form immense distributing systems from which a reasonably high load-factor can be obtained. The plan to construct a system of this kind to supply approximately 15,000,000 horse-power to consumers in eleven North Atlantic States is probably the most elaborate undertaking ever conceived, but there is reason to believe that it will be accomplished in part at least. A preliminary

report on the engineering aspects of this so-called Super-Power Survey has already been made, and the legislative, legal, and financial phases of the plan are being studied thoroughly.

Electrification of railways and the supplying of 7,000,000 horse-power for operating trains is contemplated in this huge undertaking, and similar electrification of railroads in all parts of the country is being considered. That electricity is the only logical form of power for this purpose is conceded by everyone; even though hydro-electric power be not available, there is no possible economic justification for transporting coal all over the country and burning it in thousands of locomotives instead of generating electricity at the coal mines and distributing it by copper wire. Virtually the first long stretch of electrified railroad was the division of the Chicago, Milwaukee & St. Paul road between Avery, in Idaho, and Harlowtown, in Montana, a distance of 480 miles across the Rocky Mountains. The locomotives draw 3000 volts of direct current from two '0000' bare copper wires, each of which weighs 3280 pounds per mile; in addition, the rails are bonded at every joint with three-foot pieces of the same wire; and one '000' high-tension wire and one feed-wire of 500,000 circular-mills capacity extend over a large part of the line. The total weight of copper used is about 20,000 pounds per mile for a single-track line; manifestly, the electrification of the roads, which cannot long be delayed, will afford an important outlet for the product of our copper mines during the years to come.

The United States will not be alone in equipping its railroads with electric power. Plans were matured in Great Britain in 1914 for the division of the country into power districts that were to be supplied from large central stations, where electric energy by efficient management was to be produced in steam-plants for less than a half-penny per kilowatt-hour. This comparatively low cost had already been obtained in some plants. The War postponed the necessary construction, and since the Armistice the problem of financing has been the most serious obstacle. However, the strike of coal miners has emphasized the necessity for obtaining the maximum efficiency from available fuel, and the project of electrification will be undertaken immediately. The 'Boston Financial News' recently published a summary of reported plans for electrification abroad, which we presume to be authentic. The Midi system in France has announced plans for the harnessing of water-power to supply electricity for the operation of 1700 miles of railroad, 1000 miles of which will be electrified within five years. It is said that the River Rhone alone will be developed to supply several million horse-power of hydro-electric energy. A commission has been sent by Italy to investigate the methods used in the United States in anticipation of utilizing domestic sources of water-power for operating several thousand miles of railroad. Switzerland has sold $25,000,000 of bonds in this country, the proceeds of which will be devoted to electrification, according to reports. Projects are under way in Belgium, Spain, Sweden, and Germany for the development of the electrical industry, particularly with respect to the application of electric power to railroads. According to the Federal Power Commission, the Chicago, Milwaukee & St. Paul company "forwards twice as many cars at double the speed" on the division that has been electrified as compared with the others; power costs ⅝ cent per kilowatt-hour—a figure that cannot be approached by oil- or coal-burning locomotives. In dozens of other industries the advantages are equally certain and equally important. Electricity is *the* modern form of power; its utilization as such has barely commenced. Until a practical means of transmitting current by wireless is perfected—a possibility that our electrical engineers declare is still remote—the electric-power industry should be the source of much comfort to the copper miner.

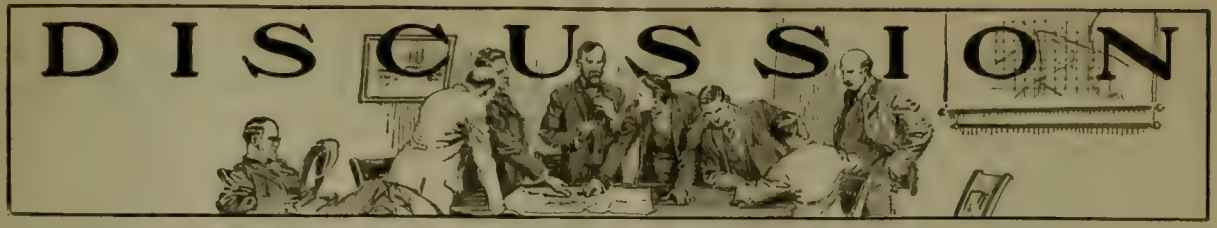
Mr. Ford and the Supply of Nitrate

"United we stand; divided we fall" is a motto that is being applied to the solution of many industrial and technical problems. Mr. Henry Ford has recognized the inter-relation of industrial efforts, and has made an offer to the Government to purchase and complete the United States nitrate plants and to lease the water-power plants in the South, using the excess power in his own business. A combination of this kind is often an essential to financial success; and it must be admitted that Mr. Ford is far-sighted. His proposal to the Secretary of War is reported to be as follows: He will take a 100-years lease on the Wilson dam, on the No. 3 dam, and on the electric-power plant when completed at a cost that has been estimated at $28,000,000. He proposes to pay interest at the rate of 6% on this amount, and to amortize not only this sum but also the entire cost of construction over a period of 100 years. He offers $5,000,000 for the nitrate plant and equipment, the lands, the steam-plants, and the other accessories, all of which cost the people of the United States about $80,000,000. He proposes to remodel the large nitrate plant (No. 2), and to operate it for the production of fertilizer compounds in time of peace, and to equip it so that it will be ready for immediate conversion into an explosives plant in the event of war. He proposes, modestly we think, to limit the profits of the fertilizer plant to 8%, thus ensuring a relatively cheap nitrogen product for American farmers. The completion of the works will make the Tennessee river navigable as far as Chattanooga. The power developed will exceed greatly the requirements of the fertilizer plant, the excess being available, at a small cost per unit, for Mr. Ford's other enterprise or enterprises. Thus by disregarding nearly all the enormous first cost of the nitrate plant at Muscle Shoals and by combining two industries under one efficient management it may be possible to produce, at a reasonable price, in peace time, that essential prop of national existence, a suitable fertilizer; and, in war time, enough of the nitrogen basis for munitions to free us from dependence on Chile. Under the conditions that Mr. Ford proposes

to attack the problem it is obvious that the completion of the project will give the enterprise a tentative commercial value. United, the two industries may be successful; divided, and under dual control, one or both might be failures.

Last year the writer of these notes had the privilege of studying Mr. Ford's methods at Detroit, the conclusion reached being that the amazing success of his efforts had resulted from an ability to apply simple fundamental principles on a large scale. A few days before, at Saginaw, Michigan, it was noticed that a valueless brine was transformed into a valuable product by the utilization of exhaust-steam from a neighboring lumber-mill. Thus it was that two industries when joined were successful, whereas, if operated separately, at least one would have been a dismal failure. A few days later, in Ohio, the immense benefit of uniting industries was again noticed. In this case a supply of brine formed the reserve of an immensely profitable salt industry, profitable because exhaust-steam from a plant supplying power to chemical works, as well as to a large cardboard plant, was available, the three industries being operated under the same management. Mr. Henry Ford had the foresight to anticipate that the same principle may be applied to the production of 'tin Lizzies', fertilizers, and explosives.

The question now arises: How will Mr. Ford's scheme affect the cost of living, for that is the question of the day. We have urged in previous issues the need for adequate provision that will make us independent of Chile for the necessary nitrate supplies in time of war. In times of peace, however, how will the cost of Mr. Ford's fertilizer compare with the price of the Chilean product? The question is complicated but extremely interesting, for the economical combination of industries is, perhaps, more applicable in Chile than elsewhere, although it is difficult to convince nitrate operators of this fact. Perhaps this is because the nitrate industry has become enervated and languid, as a result of the ease with which the high-grade caliche could be selected from a deposit of such immensity, because of the high price of the product and the availability of efficient and cheap labor. Furthermore, the death of 'the goose that lays the golden eggs' is often the ultimate result of a policy of protection of monopolies, because of the restriction of trade that ensues. Mr. Fernando Benitez, whose kindly and appreciative comment on our recent editorial appears in the February (sic) issue of the 'Boletin Minero' of the National Society of Mining in Chile, takes issue with us with regard to our condemnation of the price-raising tactics of the Association of Nitrate Producers. Our comments, he avers, raise a laugh, as coming from a country where trusts had their origin. The point that we empasized, however, was that the American companies in Chile, because of their allegiance to the laws of the United States, were not members of the nitrate 'trust'; and we opined that a greater interest in the industry on the part of American engineers and financiers would tend to break up the 'ring'. Mr. Benitez quotes the United States Steel Corporation as an American concern whose tactics have been merely copied by the nitrate producers. To this we would demur, pointing out that the activities of the Steel Corporation are not monopolistic; it is not a trust, because it does not control the iron and steel industry of this country. Our national policy and our laws are against combinations in restraint of trade, and we still think that President Alessandri is taking the right course in breaking up the trusts, combines, and pools in Chile. The recent action of a group of exporters, who tried to corner the market for nitrate, resulted in the temporary collapse of the industry. It was the stupidity of such control that we tried to emphasize. In the present case it appears that the 'pool' will be hard hit, for it holds about a million tons of nitrate, bought at about £17 per ton. The result of its profiteering tactics has been that the industry has suffered, many of the producers having been obliged to suspend operations. President Alessandri has proposed to his Congress that the Government take control of the industry. The members of the 'pool', which is backed by the Rothschilds, are becoming nervous, and a loss of about £5,000,000 appears to be inevitable. The absence of any legislation against such combinations in Chile has resulted in endless complications. In the present case it seems that the members of the 'pool' are the agents and representatives of many of the operators and hold their votes in the Association of Producers. From this it would seem that the producers may be obliged, in part at least, to pay the piper. On the other hand, the Compañia de Salitres de Antofagasta represents a powerful and influential group of Chileans, who, though not in political agreement with President Alessandri, nevertheless realize that he is a strong and able man; and consequently they will be prepared to support him in any measures he may propose to help the producers and to save the key industry of Chile from the maw of the speculators. The election of Mr. Alessandri to the presidency of Chile marked a change of administration that was ominous; his program is one that is meeting with approval and support, especially from foreigners. He realizes that rings, pools, combines, and associations that operate in restraint of trade are inimical to the progress of Chile; he will, of necessity, take steps to place the nitrate industry on a firm basis by restoring open competition, and by prohibiting the selective mining of high-grade caliche. If he takes such action and if the Government assumes the control of the industry, money will be needed to finance the purchase and the shipment of the product. The 'pool' that has succeeded in nearly crippling the industry is essentially European; such a combination must be fought with something more than moral suasion. We wish the President of Chile good luck in his well-meant efforts. We foresee a healthy competition between the products of Chile and those of the factories in this country. It is to be hoped that Mr. Ford will be allowed to carry out his proposals; he has the capital as well as the organizing ability; the combination of the two should be of national service.



Iron and Steel on the Pacific Coast

The Editor:

Sir—I have read the article by Mr. Clyde E. Williams, in your issue of July 16, with keen interest. Mr. Williams has referred specially to the coking-coals of the State of Washington, notably the Wilkinson, Carbonada, and Fairfax districts in Pierce county, and while admitting that coke made from these coals has a high ash-content, he thinks coke can be made from this coal sufficiently low in sulphur and phosphorus to be desirable for use in the blast-furnace. I am fairly familiar with the Wilkinson and Fairfax coke, having used both in foundry-work, and I am very doubtful if a satisfactory blast-furnace coke can be made from this coal on an economical commercial basis.

Referring to his remarks on the coking-coals of British Columbia, I am compelled to take issue with him. Those of us who know the coals of British Columbia never considered the Cassidy coal as a coking-coal. On the other hand, the Cumberland, or what is known as the Comox, coal is an excellent coking-coal and beehive coke-ovens have been operating there for over twenty years. It is just a question of properly washing and properly burning in order to turn out a good coke, even in the beehive oven, and in a by-product oven there is no question but a first-class metallurgical or blast-furnace coke can be made from Comox coal, although the ash-content would be higher than Connellsville. Certain seams in the Nicola valley will coke in a by-product oven. This coal is high in nitrogen and from samples sent to England to test for by-products it produced values approximating $9 per ton, plus 60% of coke as a good smokeless domestic fuel. This coal yields 30 to 40 gal. per ton of various oils and 15 to 20 lb. ammonium sulphate.

The Crow's Nest coal in East Kootenay is undoubtedly the best coking-coal on the Pacific slope. This district has been supplying the smelters with a good metallurgical coke for twenty years.

The establishment of an iron and steel plant on the Coast has become an absolute necessity, especially a blast-furnace plant for the manufacture of pig-iron. Quite recently I was commissioned by British and American interests to make a personal investigation of the market for pig-iron on the Coast. I interviewed practically every user of pig-iron, also the shipbuilding and engineering works from Vancouver to Los Angeles, and I am satisfied there is a market on the Coast for at least a thousand tons of pig-iron per day, and probably considerably more. The foundries in Oregon alone use 300 tons per day.

In discussing the question of pig-iron with the scrap-mill owners of San Francisco and Los Angeles, they assured me that the five mills would undertake to enter into a firm contract to take 500 tons per day. They are operating entirely on steel and iron scrap, but would prefer at least 40% pig-iron if they could secure it anywhere near the price of scrap, which was then $32 per ton in San Francisco. The price of pig-iron was then $65 to $80 per ton. The prevailing price of pig-iron before the War was from $27.50 to $32.50 for Scotch pig, known as Eggleton No. 2, and during my thirty years residence in British Columbia, I have only once seen pig-iron under $25 per ton.

Regarding the cost of producing pig-iron on the Coast from our native magnetic ores: In 1910 the Canadian Federal government sent out to British Columbia Mr. Lindeman, an emient Norwegian mining engineer and metallurgical expert, to look into the cost of producing pig-iron by the blast-furnace method, and he estimated that notwithstanding the higher wages and cost of other material prevailing at the time, pig-iron could be produced from British Columbian ores at a cost not exceeding $16 per ton. Siever also reported from $12.50 to $15. The high iron-content of our ores and their lack of impurities reduces the cost of producing pig-iron.

In a report that I received from Sheffield on a sample of magnetite ore from Vancouver island, they said crucible tool-steel could be manufactured from such ore at 8 shillings per ton less than from the best Norway ores, on account of the high iron-content and the lack of impurities.

Regarding competition from pig-iron made in China, I agree with Mr. Williams that we have nothing to fear from this source. They have not yet made a foundry pig-iron suitable for our market. Moreover, China will not only absorb all she can make herself, but will be a large importer of the products of iron and steel for the next fifty years at least.

Dealing with Mr. William's remarks regarding the total consumption of steel on the Coast, it is true that it consists of many different sizes and shapes without perhaps a large continuous consumption of any particular size, and I fully agree with him that it would be impracticable to construct and operate a single mill, to produce all this assortment of sizes and shapes, and that those products must be made for which there is a steady demand. He mentions tin-plate as a product for which there is sufficient demand to take the output of a modern rolling-mill, and states that the consumption of tin-plate on the Coast amounts to 150 tons per day. He is more than conservative in his estimate here, as the consump-

tion of tin-plate on the Coast is approximately 200,000 tons per year, and, in addition to this, approximately 100,000 tons per annum is exported to the Orient through Pacific Coast ports, but what we want first on the Coast is a blast-furnace plant whereby we can prove that we can manufacture the various grades of pig-iron from our native ores at a cost that will compete with the East and Europe. When this is accomplished, subsidiary companies will soon take up the manufacture of the various products of iron and steel. There already exists on the Coast open-hearth and rolling-mill equipment sufficient to take care of the merchant-bar market. What we lack is a mill large enough to roll ship-plates and large shapes and angles, and also rails up to, say, 56 lb. For the latter there is an ever-growing market.

Regarding the smelting processes that Mr. Williams mentioned: As I have already stated, a blast-furnace plant is what we want. In my opinion, there is a market on the Coast to justify the building of two 400-ton furnaces, one for the production of pig-iron, the other to be used in conjunction with an open-hearth furnace, in turning out steel billets by the continuous process. An electric furnace could also be considered in conjunction with the latter unit for the purpose of further refining, and, if necessary, making high-grade tool-steel and other high-grade steel castings. The other processes he refers to are more or less visionary.

One reason perhaps why an iron and steel industry has not been established on the Coast has been the scarcity of hematite ore, the iron deposits being largely magnetite. It has been maintained that these ores cannot be economically smelted in a blast-furnace without a large percentage of hematite to act as a flux and cheapen the cost of reduction. It is quite true that magnetites carry an extra atom of oxygen and therefore cost more to reduce to metallic iron, but I contend that the higher iron content of our magnetites, and their low sulphur and phosphorus content, more than compensates for any extra amount of fuel necessary to melt and reduce them. The magnetic ores of the Pacific Coast run from 55 to 68% metallic iron, with sulphur and phosphorus well within the bessemer limit, whereas the hematite ores of the Mesabi range and Lake Superior rarely run 50%, and are as low as 37% metallic iron. In reply to those who maintain that magnetites cannot be smelted without at least 25% of hematite, we know that in New York blast-furnaces have been operating for 30 years on 100% magnetite and on ores that are so low-grade and impure that they have to be concentrated by magnetic concentration, which also means crushing and sintering or briquetting before they can be used in the blast-furnace, so if it pays to smelt magnetic ores of this class in the East, surely it will more than pay to smelt our Coast ores, which do not require concentration and are practically free from all impurities, including titanium.

I congratulate Mr. Williams on the excellence of his article and thoroughly agree with him that the presence of an iron and steel industry on the Coast will stimulate the growth and development of the West. Its location should be decided on economic rather than on political grounds. We, in British Columbia, believe we have more and better iron ore than is to be found either in Washington or Oregon. We also have an abundance of flux, and unquestionably we have the better coking-coal, and therefore we believe that somewhere on the east coast of Vancouver island would be an ideal site for such a plant. However, our American friends have the larger market for the product and it is just a question as to whether it is better to take the raw material to the larger market and manufacture there or put the furnaces near the raw material and ship the pig-iron to the market. The main thing is to get the industry started.

Vancouver, June 20. N. THOMPSON.

Prospecting

The Editor:

Sir—The discussion on this subject suggests that the following speculations as to the history of the large body of colemanite reported to have been discovered in the extreme south-east corner of Nevada may be of interest to prospectors who have failed to acquaint themselves with the appearance of the non-metallic minerals. Some half a century ago, about the time (1866) when I piloted Governor Blaisdell's party across the desert from Silver Peak to Pahranagat, a prospector reported that he had found an enormous outcrop of rock-salt in the neighborhood of the Virgin river, and described it as extending a great distance along the side of the canyon. Those of us who are acquainted with that mineral naturally discounted the story, and anyhow a deposit of salt in such an out-of-the-way locality was not a commercial proposition. Is it not more than likely that the prospector had found the outcrop of the colemanite and in ignorance of its true value was unable to negotiate a sale, and it became a forgotten story? I have a hazy recollection of mentioning the statement in my annual report as State Mineralogist of Nevada in 1867, but not having a copy cannot speak positively. It is lucky that the men who found the salt are dead and will never know how near they came to being millionaires. The occurrence of ulexite was first noted on the Nevada marshes on that memorable trip, which opened up southern Nevada to the prospector. The character of the country may be judged from the fact that when we left Silver Peak we were lost to the world for more than three months.

Seattle, Washington, July 5. R. H. STRETCH.

The New Mining Law

The Editor:

Sir—"Pretty rotten" is the mildest criticism appropriate for that clause of the proposed new mining law that provides that mining records shall be kept in the district U. S. Land Office instead of a local recording office as formerly. Speaking for Alaska, the place for local public records is where they are accessible to the local public and not a thousand miles away where they are practically accessible only to agents and associates

of the Morgan-Guggs. How would the farmers of the States greet a proposal to remove the records of their title-deeds from the county-seat to the State capital or to Washington, D. C.? This clause illustrates how highly paid and highly respectable engineers earn their popular repute.

Kasaan, Alaska, June 29. W. W. Rush.

The Editor:

Sir—I wish to make a few comments on the 'Revision of the Mining Law' published in your issue of June 18. I have been prospecting and mining for 24 years and at the present time am the owner of two groups of lode-mining claims; on one group there is 842 ft. of tunnel and on the other group there is 200 ft. of tunnel. This work has been done by me alone with a single-jack.

First, why should the Mining and Metallurgical Society of America take such a deep interest in the welfare of the prospector and miner as to get up a new mining code?

"Sec. 5. Every full mining claim upon unsurveyed lands shall be located in the form of a square containing forty acres laid out on cardinal lines, conforming to the system of public land surveys."

The proper way to locate a lode-mining claim is to locate it on the strike of the vein, most of the mineral land that is left is in the rough mountainous regions, unsurveyed.

"B. Subject to limitations contained in this article, discovery of valuable mineral land shall not hereafter be necessary in order to locate and hold a mining claim."

Anyone with lots of money could hire men to go into the Forest Reserves and locate large areas, and by complying with C in the same section, they could set up a drilling rig, which is very easy for a man with large capital, and drill more than one hundred feet to make discoveries on each claim of 160 acres.

Under B., Sec. 6, it does not specify how or where the annual labor shall be performed and, of course, they could do it in the overburden or in the country-rock or any old place where they could do it quick and easy, or, in lieu of the performance of such labor, a sum computed at the rate of $5 for each acre or fraction thereof may be paid each year, including the year of location, into the United States Land Office for the district. That is fine for the speculator and capitalist, but it would not develop a mine.

Section 7. Prospectors and miners who have held lode-mining claims under the apex law, which gives them the right to follow their vein to the entire depth, would find their veins cut off with a vertical side-line, as this section is conflicting and it would cause litigation without end.

Section 13, under B, is where the joker comes in. Where is there any unoccupied land belonging to the public domain outside the Forest Reserves that is worth $10 per acre? Who wants to take land without limit as to aggregate area? Surely not the genuine prospector or miner! If this law should be passed by Congress, inside of ten years the biggest part of the Forest Reserves in the western part of the United States of America, and also Alaska, would be in the hands of the capitalist.

Section 25. It would be a good thing to repeal Section 2341 and 2342 of the Revised Statutes, as they have caused lots of trouble by homesteaders filing over mining property, but Sec. 2322 and Act of February 11, 1875, relating to tunnel work, should never be repealed as they have done more to help develop the mineral resources than any law that can be put on the statute-books.

The apex law under Sec. 2322 seems to be a big bone of contention. I would suggest that it be amended as follows:

"Be it enacted, etc., that Sec. 2322 of the Revised Statutes be, and the name is hereby, amended so that the side-lines of all lode-mining claims shall run parallel with the dip of the vein to its entire depth; if there are any cross-veins on said claim the side-lines shall become the end-lines of said cross-veins."

Give me the good old mining code that has withstood the test of time and under which the mining industry of these United States of America has made the greatest progress that the world has ever seen.

Republic, Washington, July 5. L. I. Munson.

Educating an Engineer

The Editor:

Sir—A good deal has appeared in print of late regarding the education of the engineer. It seems generally conceded that a too strictly technical course tends to a narrow outlook: the aim of the teacher should, it is thought, be to foster a broader vision, and a wider sympathy in the pupil. Admirable—especially if man lived longer and there was not so darned much it would be nice to know. Bacon could propose to master all the learning of his day without drawing down upon himself the ridicule of his fellows, but the man who should avow such an intention now would probably become a candidate for the foolish-house, his friends taking good care that he were safely ensconced therein and thus protected from himself.

No doubt, just as history is supposed to aid us in deciphering the future, so the experience of engineers of ripe age, if they would but set them down, ought to help the planning of a sensible curriculum. What did I study? How did these subjects help me in after life? What hours were well spent? What hours practically wasted? If the leaders of the profession would be at pains to ask themselves such questions seriously and then make known the answers, perhaps we should arrive somewhere. Just to start the ball rolling, in order that opinions of far greater weight may thereby be brought forth, I shall venture to give my own results premising that today education is conducted on far saner lines than a generation ago.

Mathematics is essential. French has come in useful in numberless instances. Latin may have helped a little, almost unconsciously, but was probably not worth the time spent on acquiring the little I once knew and have forgotten. German I never learned—sorry to say, for it

is more useful than French to the technical man. The 'teaching' of drawing, or music, unless the pupil has a real aptitude, is more or less humbug; you cannot turn out an artist or a musician unless the divine fire is present, and if it is, you cannot stop its exhibition—but an engineer hardly needs either of these accomplishments, though each may help him pass pleasant hours in even the most god-forsaken country.

As his profession will probably call him far afield, geography will come in useful; also some astronomy, at least sufficient for the latitude, time, and azimuth problems he may have to solve; and one of his closest companions during his dear old college days should certainly be a standard dictionary. It's really surprising how many eminent men cannot spell our most beautiful but puzzling language.

Looking backward, it seems to me the two subjects of study that have paid me best are Euclid and rugby football. Euclid is a wonderful mental training; even in planning the flow-sheet of a contribution to the press. Most good newspaper stories follow, unconsciously, no doubt, the general and particular enunciations, the construction, and, finally, the proof of Euclid's problems, as presented by the late lamented Todhunter, and other defunct worthies.

As for football, it teaches a lad to be active, to decide and act quickly, and is about the best training for the rough and tumble of every-day existence that I, at least, can think of.

This screed will, perhaps, attract the attention of those whose success lends weight to their opinion, and is, as will be conceded by all who honor me by reading it, more remarkable for what is left out than for what has been touched upon. But, in extenuation, Education is a big subject, and the thermometer at my elbow shows 95°F.

CHARLES A. BRAMBLE.

Winnipeg, Manitoba, July 2.

Book-Reviewing

The Editor:

Sir—The difference of opinion between Mr. Allen and myself over book-reviewing is one of proportion. My contention is that a review should give the average reader as good an idea as is possible of the book and what it specially has to offer. The review, in a paragraph or a page, should reveal the gist or heart of the book, if the reviewer has the ability to do such a thing, for it is not easy. By no means do I hold that adverse criticism, where warranted, should be omitted; in fact, the whole tenor of the reviewer's sentences should indicate his judgment of how well or how poorly the author has done his work.

Mr. Allen's opinion of book-reviewing, it seems to me, is that the reviewer should write for a much smaller audience than my suggestion indicates. He evidently would have the reviewer make little corrections and changes in the text for the benefit of the author when he prepares a second edition, much as if the author had handed him the book with the request, "Would you mind reading this proof and marking any slips that you find"? Such a review obviously has not a general appeal and is interesting only to specialists, that is, only to those readers who have specialized in the same small field as has the reviewer.

As applying to Slosson's 'Creative Chemistry', it had seemed to me that Mr. Allen's review devoted too little space to the large virtues of the book, and too much space to carping details. The book covers a wide field, being a summary of much of the recent advance in chemistry, and is a work that should be represented correctly to thousands of the readers of the 'M. & S. P.'. There was a phrase in my letter that Mr. Allen apparently misunderstood; when I wrote "with all its faults", I referred to Wells' 'Outline of History', not to Slosson's 'Creative Chemistry'. However, there is one point on which Mr. Allen and I agree, namely, that book-reviewing is neglected or poorly done in America. It is perhaps due to lack of a proper critical faculty in a land where there is so much to be optimistic over.

London, June 23. P. B. McDONALD.

American Trona Corporation

The Editor:

Sir—The Consolidated Gold Fields of South Africa, Ltd., has a reputation for probity and wise management of mining enterprises. This reputation, however, is likeely to be injured as a result of the manner in which the American Trona Corporation is being handled. There seems to be no reason why this corporation should not be successful; yet year after year goes by with nothing accomplished.

In the monthly statements one finds obscurities and shifting classifications. It is, therefore, impossible to follow the business policies. Letters written to the New York office usually bring no information. One finds among other things money expended for the construction of a refinery on leased land at San Pedro and presently the work is given up, involving a large loss to the stockholders. No explanation is made of this action. It seems strange that careful management should have proceeded with this work to the extent of nearly half a million dollars without discovering that the plan was not feasible.

It is difficult to understand why the London authorities should attempt to manage these properties in California through a sub-office located in New York. Such an arrangement necessarily involves great expense and imperfect understanding of the work. An office in California would certainly seem to be in the best position to carry out effective management. The small stockholders cannot escape the fear that the present plan is inconsistent with their interests. It is to be hoped that the Consolidated Gold Fields of South Africa, Ltd., will have sufficient regard for their reputation not to allow carelessness to ruin the American Trona Corporation.

LEON J. RICHARDSON.

Berkeley, California, June 26.

THE PLANT AT CHUQUICAMATA

The Chuquicamata Enterprise—III

By A. W. Allen

The residue from the leaching process at Chuquicamata is removed from the vats by electrically operated grab-buckets of the clam-shell type. These are of six-ton capacity in the two bridges that span six of the leaching-tanks, and of twelve-ton capacity in the new bridge that unloads the three leaching-tanks which were recently constructed. These grab-buckets deliver the material to hoppers that lead to side-discharging cars, in which the residue is hauled to the dump by locomotives. These phases of operation are clearly shown in the accompanying half-tones. A residue sample is taken automatically by means of Vezin machines that are adjusted to cut a proportion of the flow of material to the dump-cars.

The solutions from the leaching-process are handled in a special type of vertical-shaft, boot, centrifugal pump, lined with antimonial lead. The thrust is held by special oil-pressure bearings; there are no stuffing-boxes. There are eight 15-in. pumps driven by 200-hp. motors, which operate at 750 r.p.m., and four 9-in. pumps, two of which are driven by 75-hp. motors at 1000 r.p.m., and two by 50-hp. motors at 950 r.p.m. These machines were manufactured by the Worthington Pump & Machinery Corporation, and have proved entirely satisfactory.

All the strong solution from the leaching-vats goes to the de-chloridizing plant, where the chlorine in the solution, usually amounting to about 3 gm. per litre, is precipitated by means of cement copper in agitators of a special type. The resultant cuprous chloride is allowed to settle, the decanted solution (from which about 80% of the chlorine has been removed) going to the electrolytic department. The cuprous chloride sludge is removed from the settlers by grab-bucket, and is dissolved in ferrous chloride, the resultant solution being passed through cylindrical mills that are filled with scrap-iron. The cement copper produced goes to settling-vats; the overflowing ferrous chloride solution from these is used to dissolve more cuprous chloride and is returned to the precipitating-cylinders. The cement-copper sludge is removed from the settling-vats by grab-bucket mechanism, and is returned to the de-chloridizing agitators. The cement copper, therefore, remains in the circuit, being used in the first place to precipitate cuprous chloride, and later being re-formed by precipitation with iron. About 20% of the cement copper is removed from operation each cycle and sent to the melting-furnace to be cast into soluble anodes for the electrolytic-cell house.

After passing through the de-chloridizing plant the solution is pumped to the main solution head tank. This is 90 ft. long, 60 ft. broad, and 12 ft. deep, and is constructed of reinforced concrete lined with mastic. From here the solution passes to the depositing-cells, of which there are now 784; these are 19 ft. long, 3 ft. 6 in. broad, and 4 ft. 10 in. deep. Each cell has 44 ferro-silicon anodes with five bars to the anode, each bar measuring 48 in. by 4½ in. by 1 in. The cathodes measure 3 ft. by 4 ft., and there are 45 per cell. The current-density used for copper deposition when operating at full capacity is 11.4 amperes per square foot of cathode surface.

The starting-sheets are made in 64 cells, of the same dimensions as those in the 'commercial' cells, the current-density used being 18 amperes per square foot of cathode

SUMMARY OF OPERATIONS AT CHUQUICAMATA

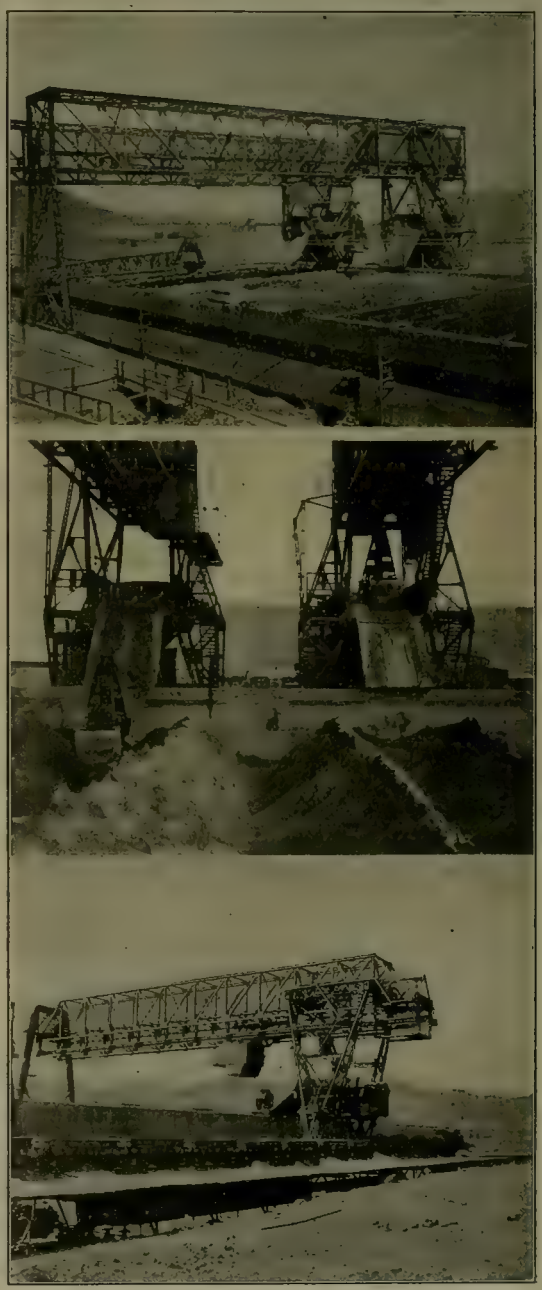
	1915	1916	1917	1918	1919	1920
Ore treated, tons	625,394	1,742,748	2,904,191	3,745,083	2,961,465	4,243,301
Copper content, %	1.71	1.74	1.76	1.64	1.62	1.54
Copper recovered, %	66.87	77.15	81.80	82.20	86.0	89.7
Copper recovered, million pounds	10.944	41.306	88.37	102.136	76.718	111.13
Net cost of copper, including selling and delivery, excluding depreciation and depletion, cents per pound	18.55	15.46	16.75	13.30	13.01	10.7

surface. The soluble anodes that are used in making the starting-sheets are allowed to be eaten away until about 20% of the copper remains. They are then replaced with new anodes; the scrap is sent to the anode-furnace for re-melting. The cells used for de-copperizing the wasted solutions are 46 in number, and are of the same dimensions as the others. The commercial copper sheets, or cathodes, formed in the cells weigh about 150 lb. apiece, and take about ten days to form. They are transported to the melting-furnace by means of a light railroad. The copper used for the production of the soluble anodes is melted in a 100-ton oil-fired reverberatory furnace, which has a hearth dimension of 26 ft. 3 in. by 11 ft. 6 in. The metal runs to a tilting ladle, and from there to a casting-machine, the final plate being 4 ft. by 2 ft. 11 in. by 1¼ inches.

There are three oil-fired reverberatory furnaces used for melting the cathodes and casting them into marketable shapes. Two of these furnaces have a hearth dimension of 41 ft. by 13 ft. 10 in., and a capacity of about 200 tons per charge. The third furnace has a hearth 50 ft. by 13 ft. 10 in. and has a capacity of 250 tons per charge. Wire bars varying in weight from 135 lb. to 275 lb., and ingot bars weighing 65 lb., are produced. The bars are tipped onto a conveyor about 20 ft. long and running at about 5 ft. per minute. This conveyor will carry up to 4 tons of copper bars, which are cooled by means of water sprays. The copper is delivered direct to box-cars that belong to the Antofagasta & Bolivia railroad, a narrow-gauge spur-line connecting the melting-plant with the station at Calama. The metal is shipped from Antofagasta, the freighting of copper and supplies being done in the steamers of a subsidiary company, the Chile Steamship Company.

Plans for the extension of the plant have been made, by which an ultimate yearly capacity of 300,000,000 lb. of copper is anticipated by crushing and treating about 35,000 tons of ore per day.

SOCAIL WELFARE. The establishment of an industry of considerable national and international importance in the heart of a desolate region in South America involves consideration of numerous problems of other than technical importance. The success of the mining and metallurgical side of the enterprise is essential, for without it the venture would be a failure. To make the industry an economic as well as a technical success, however, every detail of community life must be considered. Employees need more than their pay; they must be housed, they must be able to clothe and feed themselves, their children must be educated; facilities must be provided for the encouragement of adherence to whatever religious faith is dominant in the locality; surgical, therapeutical, and dental aid must be forthcoming when required; assistance must be given to foster physical fitness by means of games and exercises; mental enlightenment needs to



MECHANICAL HANDLING OF RESIDUE FROM THE LEACHING-PROCESS

be fostered by means of libraries, reading-rooms, and night schools; amusement and recreation must be considered, for happiness and contentment are essential to honest effort.

After a period of observation that has involved travel in all five continents and residence in four of them, I feel justified in making comparisons of conditions at Chuquicamata with those that prevail in mining communities in other parts of the world, and I have no hesitation in saying that the Chile Exploration Co. is to be congratulated on setting an example that industrial concerns are usually too slow to adopt, especially mining companies that are operating in isolated districts. The results at Chuquicamata are all the more praiseworthy in that they involved enormous expenditures, in addition to careful planning. None of this cost has come from profits, for no dividends have been paid to date; conditions are far from normal in the mineral industry, and

MELTING-PLANT

the Chuquicamata plant is not yet operating at a capacity that indicates an exhaustion of ore-reserves that approaches an economically justifiable amount. The welfare work was carried to a successful conclusion before the enterprise was a financial success, and before the mine and plant were operating on an adequate scale. Not that the money spent in this connection was the result of altruistic ideas only; welfare work, provided that it is neither patronizing nor paternalistic, is generally an indication of sound business sense on the part of the company concerned. Men that are unoccupied, either during working or during leisure hours, are liable to be the centres of discontent of some form or other; and discontent should be avoided at all costs. This, doubtless, has been an important consideration in the scheme of welfare work that has been initiated at Chuquicamata.

Few engineers who have not undertaken the management of industrial enterprises in foreign countries can realize the difficulties in the way of retaining the individual members of the subordinate groups of an American staff for any length of time. At Chuquicamata, there has been a heavy turnover of minor company officials in the past, a condition that is much improved today. In the first place, a large amount of work that was originally done by Americans is now in the hands of Chileans; the change has been satisfactory, for the citizen is, primarily, the most desirable worker in any locality, if he be capable. I have a high opinion of the Chilean laborer and mechanic; he is quick to learn and

HOUSES FOR STAFF EMPLOYEES

can be trained to observe the fundamentals of neatness and accuracy. Like others of our South American neighbors, he must be led rather than driven. He has his *vicios*, and unreliability is among them; but a large amount of mechanical work can be performed by Chileans of the better class. Many are experienced miners, and few are unaccustomed to the handling of tools. The common labor is drawn from a class that is exceptionally strong and sturdy; for manual work, especially under contract, they possess advantages over many other types.

The number of Americans, in proportion to output,

CHILEX CLUB

has steadily declined at Chuquicamata since the commencement of operations. Chileans are now used as engine-drivers, and as steam- and electric-shovel operators; they handle the drilling machines, as well as the large number of electric motors that move machinery of all kinds at different stages in the handling and treatment of the ore. The machine- and repair-shops are

manned largely by Chileans; they perform a large proportion of the actual work in connection with the melting of the copper and the shipment of the bars and ingots. The trouble (if trouble it can be called) in connection with the employment of Americans, has therefore been reduced considerably, and because of the adaptability of the Chilean. The employment of any large number of Americans abroad will, in normal times, always constitute a drawback to successful operation in foreign countries. The United States is at a disadvantage in this respect, with regard to participation in foreign industry, in connection with colonization, and in the maintenance of an American merchant marine. Men go abroad as

HOSPITAL BUILDINGS

colonists or in professional capacities because the life at home lacks something that they can obtain by going farther afield. In some cases it is a measure of freedom they are looking for, or they need experience; in others, additional recompense is the controlling factor. But unless things are made exceptionally attractive for the young American, he sees no advantage in leaving his own country. He can get all the mining experience he needs in the United States; he can earn his pay at a rate that is the highest in the world. The American standard of living is no myth, as any manager will admit who has tried to satisfy the average American employee who is working in a foreign country. The thousand and one advantages of home life are missed; and, unless the normal rate of pay is increased largely, the employee is inclined to think that he has a grievance. With the majority of other nationals there is much to be gained and little to be lost by leaving home to take up a permanent and remunerative appointment overseas. Few Americans go to Chile or to any other South American republic with the intention of making the country their home, as so many Englishmen have done in the past. The fact that a large number of employees at Chuquicamata broke their contracts during the earlier years of operation is an undeniable fact; this meant a serious loss to the company, for the efficiency of any man reaches normal only when he is *au fait* with the work and surroundings; and the expense of engaging men in the United States and of bringing them to Chile has been considerable.

During three visits to Chile I have paid considerable attention to the matter of the engagement of foreigners to work in the industries of the country, and I have come to the conclusion that the average American, in normal times, is too well-off at home to be satisfied with conditions in any other country, particularly where his own language is not spoken. There are a few notable exceptions, but the fact remains that the average American cannot conceive the idea of making his home among the people of a foreign country; it redounds to the credit of the United States that this is so; but, because of this, American expansion abroad will always be at a disadvantage, as compared with the efforts of other nationals. British prestige and influence in South America is almost entirely due, I should say, to the number of influential Britishers who are part and parcel of the national life in those countries. They may return, on rare occasions, to the land of their birth; but the hankering to do so is far less emphatic and far less frequent than it is with the Americans.

Apart from the feeling of preference for one's own country, State, or home town, I could see no justification at Chuquicamata for grumbling. The company has provided its employees with excellent houses that are rent-free. These are plainly but sufficiently furnished, the occupant having to pay only 10% of the value of the furniture per year, to allow for depreciation. Water, though expensive to obtain, is free; 50 kw. of electric power per month is supplied without charge, additional current beyond this amount being purchasable at a cost of 2½ cents per kilowatt. A club-house that cost $180,000

ADOBE HOUSES AT THE NEW CAMP

has been built and equipped for the benefit of all 'gold' or staff employees. For this the entrance fee is $10, with monthly dues of $2. It contains a fine swimming-pool, a theatre, bowling-alley, pool-rooms, ball-room, and library; it boasts of a real American barber, with complete impedimenta. A weekly paper, 'Chilex', is published in the camp.

The importance of welfare-planning work at Chuquicamata may be estimated from the fact that about 1800 dwellings and other buildings have been or are being erected, involving a total cost of about $4,000,000. The company store carries an immense variety of goods, valued at about one million and a half pesos in normal times. All the employees' houses were built to standard pattern, at first of corrugated iron, and later of adobe brick, made from screened tailing, earth, and a small pro-

portion of cement. Type *A* houses have four rooms, a kitchen, and a bathroom; Type *B* houses, three rooms, a kitchen, and a bathroom. A few larger houses, for heads of departments, have six rooms, two baths, and a kitchen. Included among the buildings erected by the company is a Roman Catholic church, of artistic mission style, that cost $45,000.

The hospital equipment is unusually complete, and consists of six buildings, with operating-rooms, separate wards for patients of different social grades, and for special cases, and a modern X-ray outfit. Dr. Shaw has

BAND-STAND AND CHURCH AT THE NEW CAMP

two assistants. The principal work at the hospital is in connection with minor and major accidents; pneumonia and appendicitis are not uncommon. The last-mentioned trouble seemed to be unusually prevalent, for which no reason can be assigned. Nine hundred cases of influenza were under treatment during the epidemic, from which there were only seven deaths. A dental surgeon is numbered among the permanent company officials, and a complete and up-to-date equipment is at his disposal.

Schools are provided for the children of Chileans and Americans. In the latter, Spanish is taught; but the number of American children at Chuquicamata is small. The Chilean school is under government control, and is staffed, partly at the expense of the Chile Exploration Co., with Chilean teachers; it is situated, together with the Roman Catholic church, at the New Camp, as it is called, where there is a large plaza and bandstand, and over a thousand small adobe dwellings for Chilean laborers. Every encouragement is offered, in the way of prizes and commendation, for cleanliness of house and attractiveness of garden.

In summary, I would like to say that my visit to Chuquicamata was as profitable in impressions as it was pleasant. The mining work being done is notable, not only on account of quiet achievement, but as indicative of a spirit of progressiveness that will undoubtedly make the property one of the world's principal producers of copper in the near future. The metallurgical practice at the plant indicated careful planning and the absence of bias in the first instance, followed by capable control. The company appears to have done everything possible to make the employees contented and satisfied with their surroundings; in those cases where failure has resulted I feel sure that the cause lies not with the personnel or welfare departments, but is the result of temperamental influences over which they have little or no control, coupled with the fact that there is no natural beauty in the immediate country.

For the Chileans themselves I have a high esteem, but in making mention of them in connection with the work at Chuquicamata I realize that I must tread gingerly. The company has done a great deal, far more than it need have done on purely humanitarian grounds. This fact has been driven home on several occasions by company officials, who have made pertinent comparison between living conditions at Chuquicamata today, as compared with conditions that prevailed or prevail in other centres in the country. It is not easy to draw attention to such matters without causing offence; comparisons are odious. That the company has tried to set a high standard is patent; that Chileans have been quick to take offence, where none is meant, is also patent. The Chile Exploration Co. has been trying to make a home for Chileans in a barren part of their own country; it has helped them in every way to become good citizens. It has done this because of a real desire to bring contentment, and because the bringing of contentment is good business, and redounds to the credit of the organizer.

In conclusion, I would like to express an appreciation

SCHOOL FOR CHILEANS

of personal courtesies extended to me at Chuquicamata by Burr Wheeler, the general manager; B. A. Middlemiss, the assistant general manager; B. C. Leadbetter, the mine superintendent; L. W. Kemp, the superintendent of the reduction plant; Dr. W. F. Shaw; L. F. Sussick, of the welfare department; and W. R. Baseden, the company's agent at Antofagasta.

DEPOSITS of antimony exist in many parts of Mexico, and a considerable quantity has been produced, according to the U. S. Geological Survey. Output was increased largely during the period 1915 to 1918. No reliable data as to mine production are available.

Resuscitation of the Octave Gold Mine

By J. Nelson Nevius

After a successful period of operation during which it produced $2,250,000 worth of gold, the Octave mine succumbed to mismanagement and was abandoned. It lay idle for several years, but recently has been re-developed so successfully as to give every promise of a profitable life for many years to come.

Octave is situated ten miles east of Congress Junction station in Yavapai county, Arizona, about half-way between Phoenix and Prescott at an elevation of 3250 ft. The town is on a patented mining claim and the company thus controls the little community. It is ten miles east of the old Congress mine, reputed to have produced $12,000,000, which was mined to a depth of more than 4000 ft. on a dip of 30°. The geology and type of veins are identical in the two mines, and it is worthy of mention that there are similar veins in the district well worthy of development. The arroyos close to Octave have made a record as producers of placer gold; Rich Hill, Antelope and Weaver gulches being the main sources of supply. Much of the placer gold is coarse; I have seen a $207 nugget taken from the Octave property, yet gold is rarely seen in the veins.

The name Octave is said to have originated from the fact that in 1897 eight men associated themselves to organize the Octave Gold Mining Co. A 40-stamp mill was erected, with amalgamation plates, concentration tables, and cyanide plant. Oil-fired boilers supplied steam-power for the mill, compressor, and two single-drum hoists. The plant was operated for several years and the vein was mined over a length of 2000 ft. along its strike and for nearly 2000 ft. on the dip.

In 1905 the property was sold to a Chicago stock-broker. At that time the bottom of the mine showed a strong vein but too low-grade to be profitable, and to the east the vein was cut by the Joker fault, as described later. Whether these unfavorable factors influenced the sale is conjectural, but they were never overcome by the new owners. Thus closed the first chapter.

Then began a period of stock-jobbing. The evidence underground, a mill ore-bin a third full of waste, and the correspondence left at the office, tell the tale of the wrecking of a good-mining enterprise. The climax came after the construction of an electric power-plant at Wickenburg, an 11-mile transmission line to Octave, and a complete electric equipment for operating the mine, the mill, and the town. This equipment is said to have cost $150,000, but it was used less than two weeks. The company had no ore in the mine and neither cash nor stock in the treasury. Thus ended the second chapter.

Several years ago some of the bondholders engaged me to advise them whether the geologic evidence indicated a reasonable probability of successful re-development. My report was favorable and resulted in the organization of the present Octave Mines Company, in which all former participants of record were invited to join on equal terms. H. C. Gibbs, of Boston, president, and Donald S. Leas, of Philadelphia, secretary-treasurer, have carried the burden of the financing. Before undertaking the heavy expense involved the company wisely engaged Wilbur H. Grant, of San Francisco, and later Mr. Miller, of New York. Both of these engineers reported favorably.

The new development was undertaken under my direction. The vein was recovered beyond the Joker fault by hand-drilling, and after drifting in good ore for several hundred feet a compressor plant, consisting of a Fairbanks-Morse Y engine and Sullivan angular-compound compressor, was erected, the camp was rehabilitated, and ore development was begun in earnest. The vein was recovered on the 850-ft. level of the Joker shaft, which corresponds to the 250-ft. level of the old mine. Reference to the accompanying map will explain the details. The 850-ft. level disclosed a continuous orebody for 730 ft., then encountered another fault, which had not been passed when work was suspended. Although this fault is a nuisance, it is not serious. The vein will be recovered beyond it, and the outcrop indicates that the vein is continuous for 3000 ft. farther within the company's property. Profitable ore has been found beyond the Joker fault also on the 600-ft. and 1000-ft. levels of the Joker shaft, and, with the exception of the 850-ft. level, all the working faces are now in ore, and further development will place more ore in reserve. The face of the 1000-ft. level shows a vein 52 in. wide assaying $26.50. Within the boundaries shown on the map there is 40,000 tons of ore assaying $14 per ton, with a gross value of $560,000. The cost of the actual development of this ore was about $55,000. There are 800 ft. of backs above the 600-ft. level to be developed, and if this ore goes no deeper than the bottom of the old mine, it gives 1500 ft. on the dip below the 1000-ft. level yet to explore. The map shows the relations of the new ore to the old workings and suggests the long life that may be expected on this one orebody. Then there is 3000 ft. of ground east of this ore, marked by a strong outcrop, yet to be developed.

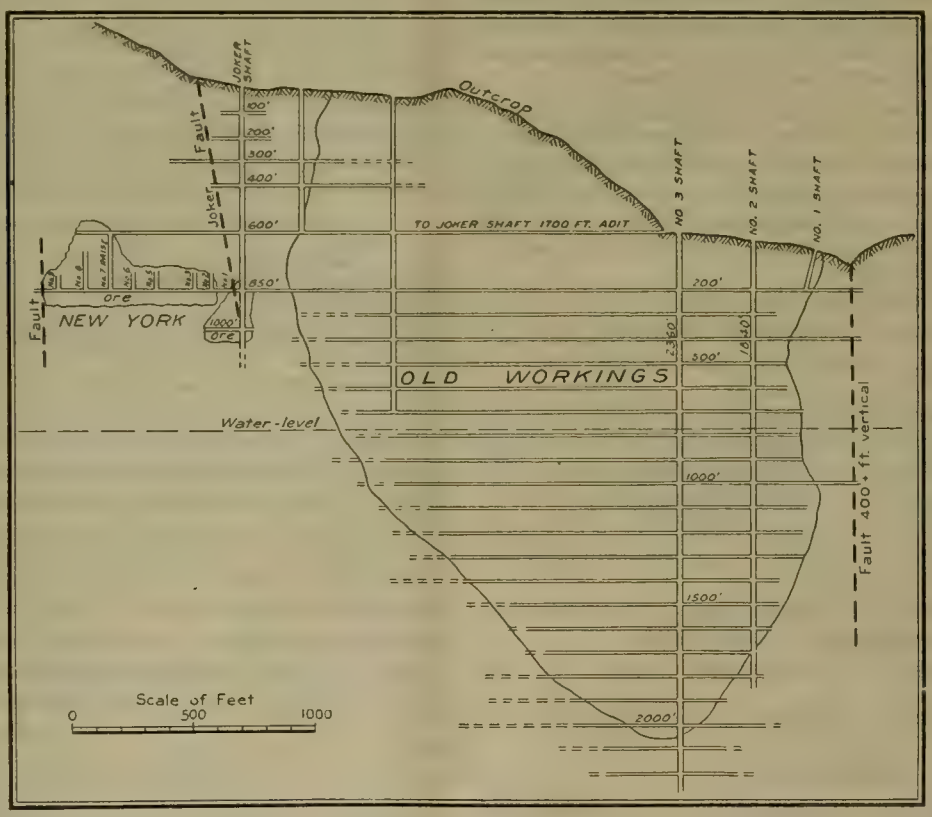
The old mine has not been unwatered. Many miners have told me that the vein in the bottom is four to five feet wide, but low-grade. As the Congress mine was operated profitably to twice the depth of the Octave, there is sufficient encouragement to unwater the mine and sink deeper, but this is for the future.

Development had gone far enough to justify a new mill when war conditions made it advisable to suspend operations temporarily. Mill-tests made by Hamilton,

Beauchamp & Woodworth indicate that a recovery of 96% can be made by a simple process. With the return to more normal conditions a new plant will be built using the old mill-building. Meanwhile no damage accrues to the mine by waiting until the bankers discover that gold is essential to our financial stability.

The Octave is an object lesson, showing that a mine may be abandoned before it is exhausted. When I first saw it the mine was a discouraging mess, both underground and on surface. The conditions were such that to the east the prospect was hopeless because the vein is cut by a profound fault at the base of the mountain. Sometempt, the displacement being 50 ft. *to the right*. More recent work has given some evidence of the existence at this point of two parallel veins about 50 ft. apart, and the Joker fault ends—like a tear part-way through a sheet of paper—at about this level. As exposed in the Joker shaft, the vein shows a sudden wave just above the 1000-ft. level, but no faulting occurs there, yet in the upper levels and on the surface the fault is unquestionable.

The Octave vein is one of several similar veins along the base of the mountains, which are composed mainly of a coarse-grained granite, such as encloses the Congress



SECTION OF OCTAVE WORKINGS

one had sunk a shaft said to be nearly 400 ft. deep and failed to get below the loose material of the wash. The bottom of the mine was not accessible because the mine was, and still is, filled with water to about the 800-ft. level. The west limit of the old mine was in the Joker fault immediately beyond the Joker shaft, and the work indicated frantic but unintelligent efforts to recover the vein.

A peculiar situation existed in that the evidence on the surface indicated a displacement of about 200 ft. to the left, where a strong vein shows near the top of the ridge, but the evidence underground equally strongly indicated a displacement to the right. As the effects of faulting were diminishing with depth, the 850-ft. level was selected and the vein was recovered at the first at-

and the Alvarado veins. At Octave, although the mass of the mountain is granite, yet the vein is enclosed in coarse-grained grano-diorite that was intruded prior to ore deposition. The vein is a persistent quartz-filled fissure. The fissure has been re-opened several times and in places the rock shows shearing. At the mouth of the adit the grano-diorite is sheared to a schistose structure for a width of 25 ft. and the quartz is only six inches wide. In places in the mine, the vein-fissure has been re-opened along the quartz and filled with rhyolite; in other places diorite has similarly been intruded in the fissure through cross-cutting dikes later than the ore. At Raise No. 7 on the 850-ft. level such a dike cuts the vein cleanly in the drift without displacing it, whereas in the raise the intrusive rock has spread out in the vein over the ore. The

vein strikes north-west and dips south-west at about 30°. In width the quartz varies between nothing and five feet. The average width of the new orebody is scant 30 inches. A thin selvage occurs on both walls, so the ore breaks clear of the walls, and both walls are hard and unshattered, timbering being unnecessary except where faulting has occurred.

The vein is composed of white quartz carrying 4 to 5% of sulphides, pyrite predominating, but galena, sphalerite, and chalcopyrite occur sparingly. About 60% of the gold is free and 40% is in the sulphides. It is noticeable that where the galena increases the gold increases. Although certain differences can be noted, the characteristics of this vein are almost identical with those of the veins at Grass Valley, California. One rarely finds conditions so similar in districts so far apart.

About 10% of the value is in silver, and both precious metals are rather uniformly distributed throughout the vein, assays rarely falling below $5 or reaching as high as $40. No coarse gold has ever been found in the Octave vein; and this is peculiar because the local washes yield numerous good-sized nuggets. Only rarely may any fine gold be seen in the ore.

As regards the delineation of the old mine on the accompanying map, the ragged line merely outlines the periphery: it does not mean that the entire area was stoped.

The reasons for recommending re-development constitute probably the most important part of this story and the most difficult to put on paper. Reverting to the time of the original examination, the favorable facts were:

1. Duplication of vein-structure and ore-deposition with those at the Congress mine, which was profitable to twice the depth.

2. Similarity of vein-type and ore-deposition with those of the classic veins of Grass Valley.

3. Continuation of vein-outcrop beyond the Joker fault.

4. An indefinite condition that made the Octave look 'right'.

The unfavorable facts were:

1. A successful company had sold the property, probably considering it about worked out; and a second company had spent much money on it and failed.

2. No chance for ore to the east. Bottom of mine inaccessible and further exploration at depth (2000 ft. on an incline of 30°) would involve very heavy expense.

3. To the west the vein was faulted and surface and underground evidence apparently was contradictory as to displacement.

4. Outcrop beyond the fault reasonably continuous, but almost devoid of pay-ore.

5. Old stopes showed the vein to be narrow and flat, with numerous though not large bodies of ore.

Reduced to print, the above brief does not make a strong case in favor of re-development. There are some things that can be recognized but not described, and I take refuge in No. 4 of the above list of favorable conditions.

Cadmium

There are several cadmium minerals, but none of them occur in quantities large enough to be called ores, states a U. S. Geological Survey bulletin. The cadmium of commerce is derived from zinc minerals and ores, in almost all of which it occurs in minute quantity, the ratio being about 1 of cadmium to 200 of zinc. Cadmium behaves metallurgically almost the same as zinc, and hence constitutes a fraction of 1% of almost all metallic zinc. The sources of cadmium that have been utilized are zinc ores treated by fractional distillation, lead-furnace baghouse fumes (the cadmium content of which is derived from the zinc minerals contained in the charge of lead ore), and residues from the purification vats of electrolytic-zinc plants and lithopone plants. The production of cadmium, either as the metal or as the sulphide, has been reported by the companies in the following list, which shows also the nature of the metallurgic plant in connection with which the cadmium plant is operated:

Producers of Cadmium in the United States in 1920

Company	Associated plant
American Smelting & Refining Co, Denver, Colo	Lead smelter
Graselli Chemical Co., Cleveland, Ohio	Chemical works
Krebs Pigment & Chemical Co., Newport, Del	Lithopone plant
Midland Chemical Co., Argo, Ill	Lithopone plant
U. S. Smelting, Refining & Mining Co., Kennett, Cal.	Electrolytic-zinc plant
U. S. Smelting, Refining & Mining Co., Midvale, Utah	Lead smelter

Of these, the plant at Kennett, California, was reported to have made no output in 1920. The lead furnaces at the Globe plant of the American Smelting & Refining Co., at Denver, have been closed for some years, but stocks of cadmiferous residues remain from former operations, and more has been shipped in from other plants of the company. Several other electrolytic-zinc plants and lithopone plants save cadmium-bearing residue and have developed processes for recovering the metal, so that an extension of the uses of cadmium and an increased demand for it would result in additions to the list of producers. Several companies that produce cadmium-bearing residues sell them to the producing companies named above.

A NEW METHOD of determining surface tension is proposed by A. Ferguson in a paper that was read recently before the Faraday Society. Instead of measuring the height to which a column of liquid rises in a capillary-tube, external pressure is applied to force the level of the liquid to the bottom of the tube, this pressure being measured by a delicate manometer. Among the advantages claimed for this method are that it avoids difficulties due to variations in tube diameter and to variations in temperature in the capillary-tube itself; also the capillary-tube may be very short, which facilitates cleaning. The method is rapid in use, and it gives results which are in good agreement with those obtained by the best methods previously known.

ACCORDING to the U. S. Geological Survey, 1% of the salt in the ocean would cover all the land areas of the globe to a depth of 290 feet.

Baja California and Oil Possibilities

By Victor H. Wilhelm

The area covered in this reconnaissance is mainly in the southern and central parts of the peninsula extending on the Pacific side from Cape San Lucas to Magdalena Bay, and on the Gulf side from the Cape to Santa Rosalia.

Baja California, or Lower California, consists of a narrow strip of broken mountainous land, 775 miles long and varying from 30 to 75 miles wide, and in general trends northwest-southeast. Its coast is characterized by long sweeps of gently curving bays, with intervening points enclosing oval basins, with outlying islands. The interior consists of a series of mountain ranges made up of recent volcanics, and submerged mountain masses that are an extension of the Sierra Nevada uplift.

The climate is remarkably equable, being little warmer than southern California, although much more arid. Large areas on the Pacific side have an annual rainfall of less than two inches, and the mountain areas average less than five inches. The entire area is a desert, with the exception of a few small valleys, where arroyos supply sufficient water for irrigation. The raising of cattle is the main industry, but considerable sugar-cane is grown where irrigation is possible. Most of the corn and beans, the staple food, are imported from the mainland. Pearl-fishing has been an important industry, but the beds have been worked out since the cancellation of the French concession.

The southern portion of the peninsula classifies itself naturally into two districts: (1) the area south of La Paz, on the Gulf, and Todos Santos on the Pacific, consisting mainly of granitic intrusives, gneiss, and schist, bordered on the east by a series of Tertiary and Pleistocene sedimentaries, and (2) the area running north from La Paz to Santa Rosalia, consisting of large deposits of limestone, sandstone, and volcanic tuff, forming mesas, with recent rhyolitic and basaltic flows.

The area situated south of La Paz consists mainly of granitic gneiss, probably of post-Jurassic age, cut by numerous dikes, of irregular size and continuity, the most prominent of which are syenite, diorite, and diabase. In places the original granite has been altered to hornblendite, of a schistose character. This area consisted of an island during the Cretaceous period, as the area to the north was submerged during deposition of the mesa sandstone of Upper Cretaceous age. This island was of considerable extent and of an irregular outline.

There has been considerable mining at various times in this district. The mining town of Triunfo, situated 20 miles south of La Paz, is the site of the operations of the Progresso Mining Co., now called the Minas y Montes, of which Blamey Stevens is general manager. The properties of this company have been operating for over 50 years. The ore contains lead and silver, associated with arsenopyrite, and is of a refractory nature. Two mills have been operated, using hyposulphite and cyanide processes after roasting. The various mines of the company are connected with the town of Triunfo by a narrow-gauge railroad. The mines contain 60 miles of underground workings, having been developed to a depth of 2700 ft. along the dip of a flat vein, averaging 35°. The orebodies consist of two well-defined fissure-veins in the granitic gneiss. One of these veins has been worked

MAP OF BAJA CALIFORNIA

for a distance of seven miles along the outcrop. The other vein, situated near San Antonio, extends continuously for a distance of five miles. The veins average from 3 to 7 ft. in width, and the ore, after sorting, averages 50 oz. of silver per ton. This company has had a total production of over $16,000,000. The property is now under option to the Boleo company, which is financed by the French Rothschilds. The mines are not being operated, owing to a series of difficulties, the principal of which are the low price of silver, the wrecking of the mills by a local cyclone, and the fact that the properties were confiscated and looted by the Carranza government.

Labor is plentiful, efficient, and cheap, and the climate is healthful. There are numerous other small mines in this district, only one of which is operating on silver ore, and exporting arsenic as a by-product.

In the southern area there is a considerable extent of sedimentaries, bordering the Gulf coast, running from Buena Vista to San Jose del Cabo and extending inland for a distance of 15 miles to the sierras of the Cape region. Along the granitic and rhyolitic peaks are enormous deposits of unclassified and unconsolidated material, which Gabb states are the remains of glacial moraines, but signs of glaciation are totally lacking. These deposits cover a large area surrounding Miraflores and San Bartoleo. The bedded deposits occur almost in the attitude of deposition with a slight western dip due to an uplift along the Gulf coast. The beds present a west-facing escarpment, with steep dips along the edges, rapidly flattening in depth. Three distinct formations, lying conformably upon each other, were observed at this place. The oldest formation, probably of Upper Cretaceous age, consists of coarse indurated sand, in places with a greenish color, due to traces of copper carbonates, and also containing thin beds of crystalline gypsum, and some small seams of brown lignite. Several sulphur springs were observed seeping from this formation. Lying conformably on the gypsum are over 1000 ft. of fine-grained sandstone and clay-shale, including sundry beds of limestone made up of shell formations containing a large species of *ostria*—probably of Miocene age. Seemingly conformable with the Miocene is a large series of Pleistocene conglomerates and granitic sands, which border the glacial moraines.

Despite the many exposures of tilted strata, there were no evidences of oil seepages, although some specimens of ozokerite have been found along the beach.

After leaving the granitic ranges south of La Paz, the entire character of the country is altered, the older igneous rocks are replaced by enormous deposits of sandstone, limestone, and massive conglomerate, forming mesas, or flat-topped ridges, and the backbone or higher portion of the peninsula follows the Gulf coast. These beds form rugged and precipitous escarpments along the Gulf coast, but dip gently to the Pacific side. Along a belt bordering the igneous rocks, running from La Paz to Todos Santos, the limestone in the sedimentaries has been altered along the contact to a fair grade of marble, which still shows the fossil contents of which it is made. This marble has been quarried for export, at Pescadero, adjacent to Todos Santos.

Traveling north, from the small town of Todos Santos along the Pacific coast, recent marine terraces, probably Quaternary, are observed. These terraces are of considerable extent near Magdalena Bay. At Point Cedros, 60 miles south of Magdalena Bay, the mesa formations of the Pleistocene, dipping westward at a uniform angle of 4°, outcrop along the coast. This formation was made up mainly of shell beds of marine origin, in which the fossil forms are well preserved. A section at this place consists of shell beds, containing *turritellas, olivas, patellas,* and *ostreas,* 60 ft. thick. Upon these beds are sandstone and volcanic tuff, more or less consolidated, underlying beds of volcanic ash, showing spicules of sponge forms. The surficial formation everywhere consists of massive conglomerate, made up of large boulders of eruptive material, loosely consolidated. To the eastward, in the higher mesas, these beds are penetrated and capped by deposits of volcanic origin, mainly trachyte and rhyolite. The Pleistocene is nowhere over 1000 ft. thick, and the volcanic flows average over 200 ft. in thickness. The Cretaceous can be distinguished from the Pleistocene by its unconformity, coarser grain, greater compactness, and the large number of boulders and pebbles embedded in it.

At Point Gasparino, 40 miles south of Todos Santos and 70 miles north of Cape San Lucas, on the Pacific side, there is a considerable accumulation of asphaltum and oil-residue on rocks of igneous origin. This deposit has attracted the attention of local residents for many years. The point of rocks is made up of granitic gneiss, and the oil has probably been liberated from seepages in the ocean to the north, and carried by the prevailing southern current, on the surface of the ocean, to be deposited on the north side of this point. At Point Cedros, on Pleistocene shell-limestone, a similar deposit was observed, but with no indication that the oil originated at this place. The U. S. Coast and Geodetic Survey has noted or received notice of the presence of large areas on the ocean covered with oil, which is probably caught on the projecting points of the coast. At Conejo, 60 miles south of Magdalena Bay, concretionary float limestone impregnated with oil was found at a considerable distance from the beach. There is a large deposit of carbonaceous shale at this place, but the impregnated limestone was not found in place. At Purissima, 40 miles north-east of Magdalena Bay, an oil-well 900 ft. deep was sunk by Mexicans in 1910, but they discovered only a considerable flow of heavily mineralized artesian water.

Inorganic sediments make up nearly the whole of the sedimentary beds in this district; they consist principally of the decomposed remnants of igneous rocks. Folding or flexure of the strata is entirely lacking, the only movement being the result of a gradual uplift along the Gulf coast and a consequent slight dip to the west.

Traveling north from La Paz along the Gulf coast, the line of the peninsula presents a ragged precipitous appearance, with definite west-dipping escarpments. The outlying islands consist mainly of rhyolitic flows, dipping westward conformably with the underlying Pleistocene shell-beds. At San Evaristo, 50 miles north of La Paz, bedded volcanic ash and tuff, impregnated with malachite, were observed. At Carmen island, lying east of Loretto, an oil-seep known to the inhabitants for many years was observed dripping from the overlying rhyolitic flow, probably through a fault or break in the volcanic material. Small boats have observed several other seeps at a distance from the land, such areas being supposed to be calm in the severest storms that sweep the Gulf. A similar seepage and residue of asphaltum has been discovered on the south end of Isle de la Guardia, in the

northern portion of the Gulf, not far from the mouth of the Colorado river. These evidences of the presence of oil undoubtedly come from the mesa sandstone, forced out from the porous formations up the dip by hydrostatic pressure.

The sedimentary formations of Baja California seem to be absolutely lacking in anticlines or folds favorable to the accumulation of oil in commercial quantity. The oil probably has escaped for generations out of the open edges of the beds along the Gulf coast, as the formations are nowhere sealed. This would indicate that the oil has escaped as fast as it has accumulated. Diatomaceous shales such as are the source of the oil in southern California are entirely lacking. The prevailing vulcanism, which has prevailed during the sedimentation, is an unfavorable factor. The great extent and porosity of the beds would indicate that the oil has been rapidly replaced by water, and the oil forced out of the tilted edges of the strata. Drilling for oil where such seepages occur, through the sedimentaries back from the dip, would be useless, because no accumulation of oil could be expected.

Hints to Speculators and Investors in Mines

From a Cornish Book Published in 1857

1. Use great caution when a mine is represented as being capable of being commenced without machinery; or as being able to be wrought with an unusually small amount of capital.

2. Refrain from any mine proposed to be wrought by steam machinery with less capital than £5000, unless you are fully satisfied by your own *personal* examination. No mine ought to be undertaken without the possible resource of a surplus capital. Nine out of ten mines which have been cramped for capital have failed.

3. Be cautious when the Purser of the mine is a trader or shopkeeper. Mining capital is useful to extend private trade. Look to the Purser well, lest he look to himself too well; lend to him personally rather than indirectly.

4. Resident shareholders sometimes take shares in a neighboring project, if it will drain their own mine of water accumulated in it. Beware of projects got up by such gentlemen.

5. Avoid mines of which the traders in supplies have an agency, or in which their special friends are strong and numerous.

6. Avoid mines belonging wholly to non-resident shareholders, and which are left to the unchecked control of the Purser and Captain.

7. Look well to the registry and transfer of shares, if entrusted to the Purser alone, by means of entries in the cost-book only.

8. Avoid mines of any metal except tin, the leases of which are incomplete, or have been granted except by the sett and signature of the lord's agent in the cost-book.

9. The repute, skill, and character of the Purser and Captain of the mine you invest in, are quite as important to you as your skill in your own business.

10. Reference to an agent of uncertain character sometimes leads to a depreciation in the concern *you* are thinking of, and a recommendation of the concern *he* is thinking of.

11. What exactly suits the views of a mine agent, may not exactly suit yours.

12. It is far easier to put tin into a mine, than to get tin out of a mine; and it is more likely that you will lose £100 than gain £10.

13. To determine the number of shares you will take in a very promising mine, first consult your wife, then count your children, and lastly, calculate your household expenses.

14. It is just possible that the sample ores you see in London, or some other city, have come from any mine except the one projected, or offered to your consideration. Some samples have been known to serve for several mines.

15. As to foreign concerns, beware of wonderful reports and astonishing specimens. Not long since, some most rich masses of copper were exhibited in London, and a company projected. A keen agent, being sent out to report, found no such wonderful masses of copper, and hinted that more specimens had been *brought* to the spot by the hand of man than the hand of nature.

16. Before you invest, do not look over a list of mines whose returns have been extraordinary; but reckon up the failures. Be sure to be particular about these, as they will most concern you.

17. When you have invested, make up your mind to lose; and then any gains will be clear gains, and pleasant disappointments.

It is natural that an investing country, where, though its mineral deposits are meagre, metallurgical industries are as important as in Belgium, should have widespread interests in foreign mines. The capital of foreign mining companies (apart from coal) incorporated in Belgium may be placed at 73,181,000 francs, states a consular report. These companies exploit or control gold mines in South Africa and Australia, and operate zinc, lead, iron, and copper mines in Spain, Portugal, Sardinia, Tunis, Algeria, and Serbia. Among the largest of these mining companies are the Mines de Fer de Rouina (Algeria), capitalized at 8,750,000 fr., which operated profitably from its founding in 1908 to the outbreak of the War; the Société Minière Belge "La Productora y Coto San Antonio" (capital 7,500,000 fr.), holding lead and silver deposits in Spain, which did not show satisfactory results till 1920; and the Cie. Royale Asturienne des Mines (capital 6,000,000 fr.), operating, aside from Spanish coal mines, calamine and blende deposits in the Provinces of Santander and Guipuzcoa. Belgian capital has been widely distributed in foreign undertakings, the total amount of which may be estimated at 100,000,000 fr. The Banque d'Outremer and Belgian paper manufacturers have organized the Belgo-Canadian Pulp & Paper Co., with a capital of 4,500,000 fr. and an annual production of 35,000 tons of paper.

Our Anomalous Patent Office

By K. P. McElroy

*"What's the matter with Kansas?" is an old question that never did receive a satisfactory answer until Kansas became prosperous and contented. Afterward, it needed none because it wasn't asked. Answering, or ducking an answer to, the same question about the Patent Office is becoming monotonous. The Office is prosperous enough, in the sense that it takes in more money than it spends; but it is far from contented. That it is in a bad way is shown sufficiently well by the number of employees leaving or about to leave. The Patent Office has always been, more or less, a sort of brooder or incubator for patent solicitors; and just now it is more so; much more so. It is full of cocoons awaiting butterflyhood. To use army slang, its morale is shot full of holes.

It is a serious and perplexing situation to American inventors and manufacturers to whom a strong and virile Patent Office, playing the game according to the rules, is a business necessity. What we are going to do about it is not evident. The Nolan Bill, so far as it related to the inside of the Patent Office, was treating symptoms and not a disease. Rehabilitation cannot be accomplished by the simple expedient of raising salaries, although it would help. It is unquestionable that the good men in the Office, of whom there are many, should receive salaries commensurate with their merit. But men of education and standing need something more than salary to keep them on the job; they require a certain amount of pride of place and dignity of position. Obviously, if a man is merely paid what he is worth and what he can command elsewhere and there are no other inducements, inertia is all that holds him. The cold fact is that, quite apart from salary, to the man in the Patent Office the outside looks more attractive than the inside. The Nolan Bill in no way cures this.

As I see it, it is to the work of the Smoot-Reavis joint committee, charged with revision and co-ordination of all government activities, that we must look for relief. That that committee will do something to the Patent Office is certain; that it will do much for it, is to be hoped. Also, it ought to be urged; and it is up to those interested in patent matters to do the urging. The committee is free to do what it considers right, for there is here no question of economy, elimination, or reduction. The Patent Office pays its own way; it costs the taxpayer, ordinarily, not one solitary nickel. And it must be big enough and equipped to handle whatever business comes before it.

Intrinsically, the Patent Office is a highly dignified institution, going back to the Constitution for its warrant for existence. It has been the birthplace of many of our great industries, and there is none that does not owe it something. Its records are the records of our national industry. A fire in the old near-white building would be more terrible to industry than an army with Zeppelins. Its personnel is charged with duties requiring not only a knowledge of every branch of human endeavor, but of the principles of law as laid down in the statutes and countless decisions.

Actually, it is a mere bureau in the Interior Department bracketed with a miscellaneous lot of other bureaus, not to mention St. Elizabeth's Asylum and Howard University. What it is doing in that gallery, or in any executive department, I do not know, because it is in no sense an executive branch of the Government. It executes no orders of the President or of Congress—least of all, any by the Secretary of the Interior. Its employees are 'Examiners'; but Washington is full of Examiners. I remember one time when I was in the Patent Office and we were short-handed, the powers that were, to whom all 'Examiners' looked alike, detailed some from the Pension office to help out—with chaotic results. There is but little dignity in the title; and less official recognition than there ought to be. The head of the Patent Office is a Commissioner; but Washington is full of 'Commissioners' of all sorts—of pensions, of lands, of fishing, of Indians, of education, and what not.

Under the Constitution, the Patent Office is there to promote the progress of science and the useful arts; but it is to do it within the limits of certain statutes for that purpose made and provided. Therefore, its work is a blend or mayonnaise of law with science and technology. In the case of a patent, as with a contract, the wording is as important as the matter; what it covers depends upon what it says and how it says it, and not at all upon what it ought to say or ought to mean. A patent, to quote good old Dr. Squibb's statement, is a "law of the land"; and it is not to be granted without due consideration of all the legalities. When an application is filed, whether the invention be in determining the parallax of the fixed stars, in curing meat, or in sewing shoes, it is first referred to Examiners who are supposed to be expert in the particular art, familiar with everything that has ever been done in it, and prepared to understand the new thing; and to be able to apply their knowledge to it in view of the numerous controlling decisions in patent cases. This is a considerable requirement; but normally the Patent Office 'gets away with it'. The examining branches, of which there are about forty, are presumed to be manned by scientific and technical men of high standing, acquainted, among them all, with every branch of knowledge. The Examiners are the judges (jury maybe would be a better term) of the fact. From them an appeal lies to a Board of Examiners-in-Chief, members of which are appointed by the President with the consent of the Senate. Under the law, they must be persons of "competent legal knowledge and scientific ability". From the Board, a further appeal lies to the Commissioner in person, who, therefore, in this capacity acts as a court of appeals. General Dyrenforth, himself at that time an Assistant Commissioner of Patents, summarized the procedure neatly, albeit somewhat scurrilously, perhaps, in saying: "A case first goes to an Ex-

*Abstracted from the 'Journal of Industrial and Engineering Chemistry'.

aminer who knows the facts but not the law, then to the Examiners-in-Chief, who know the law but not the facts, and then to the Commissioner who knows neither".

In all its functions, the Patent Office acts as a tribunal to try to ascertain fact and law. It settles the question of ownership as regards certain alleged treasure trove between the inventor and the public, or between rival inventors, as the case may be. The Examiners are triers of fact, the Commissioner settles the law, and the Board tries both fact and law. In each and every activity, the Patent Office acts as an adjudicating body; not as an executive body. It is really a court, and should rank as such; not as a bureau of an executive department.

The importance of all this is that much depends, industrially, on the kind and quality of patents we are to grant; on the accurate working of our patent system. Bad patents, of which there are many, are as much of a public nuisance as good patents are of public benefit. All applications for patent should be as carefully scrutinized and examined as human ability will permit, and the interlocking team work on fact and law, provided for by statute in the Patent Office, should be at least as good as that on a baseball nine. Any patent may furnish the basis for litigation, often bitter and prolonged, and the more there is of this, the worse. Well-drawn and proper patents, like well-drawn contracts, seldom get into court; they are respected. A good patent on a good invention seldom needs litigation; the respective rights of the inventor and of the public have been settled in the Patent Office, once for all. On the other hand, a weak patent on something of importance usually does go to court and proves expensive for the owner, the industry, and the public at large. Frequently in such a case, where the patentee is lucky, the courts by judicial interpretation give the patent the form and meaning in which it should have emerged from the Patent Office in the first place. It is better for everybody that a patent, if granted, should be well granted. And to do this, it is necessary that the Office be manned and headed by competent men taking pride in their working together.

What the Smoot-Reavis committee on reorganization should do, in my opinion, is to lift the Patent Office from its lowly place in the Interior Department and make it independent, affiliating it with the judicial branches and not with the executive. I think it should be re-named the 'Court of Patents', and headed by a judge taken from the Federal bench; preferably a good crisp one. The Examiners should be high-class men, looking forward to a career in the Office, and with office conditions made attractive to them—much more attractive than they are now. All this will of course cost more money; but why not? It is not the Government's cash or the taxpayer's cash—it is the money of those doing business with the Patent Office. And those who pay the fees are entitled to get service for their money; service of a grade that they do not receive today.

The increase of filing fees provided for by the Nolan Bill is all right in and of itself, if it helps better the Patent Office. The present fees are not burdensome, nor would the increase hurt anybody. But what's the use of providing more income to an institution that is already charging more than the value of the services it renders! Put the Patent Office on a better footing and then charge more. It is absurd to take the money of the inventors and use it to run a post-graduate kindergarten for patent attorneys.

ALASKA has produced about 972 tons of metallic tin, which has nearly all come from the placers of the York district at the west end of Seward Peninsula. Tin deposits, both placers and lodes, were discovered by the U. S. Geological Survey in 1900 and 1902. Developments began in a small way on placer tin in 1902 and the first dredge was installed in 1911. Since then two or three dredges have been employed in tin mining. A number of discoveries of lode tin have been made in the York district. Practically no tin has been produced from lodes, but lode developments have been under way since 1903. The only considerable underground exploration has been at the Lost River mine, where a mill is now under construction. Some placer tin has also been produced incidentally to gold mining in the Hot Springs district of the Tanana valley and in smaller amounts in other Yukon districts. Placer tin has also been found in the gravels of Yentna river, which is tributary to the Susitna. Though there has been systematic search for tin in Alaska during the last two decades, promising deposits have been found only in the York and Hot Springs districts. No new deposits of placer tin have been discovered in the York district in recent years, and there is no certainty that this form of tin mining will be continued there when the deposits now being exploited are exhausted. No tin placers which, under present economic conditions, will warrant exploitation for their tin alone have yet been found in the Yukon districts. When costs of operation are reduced, placer-tin mining may be developed in the Hot Springs and other districts. The distribution of the alluvial tin in this district also justifies the hope that tin-bearing lodes may yet be discovered. Meanwhile, the best hope of the continuation of Alaskan tin mining is based on the lode tin of the York district. The Lost River mine, in this district, is the only property sufficiently developed to justify the belief that it will soon become a producer, yet there are other deposits in the region which deserve prospecting. These facts do not indicate any large potential tin reserves in Alaska, but the wide distribution of the tin deposits gives hope of future discoveries. There is no evidence that the tin output will decrease in the near future, yet a large increase in production must depend on the development of deposits not yet discovered.

THE production of primary zinc from domestic ores in 1918, according to the U. S. Geological Survey, was 492,405 short tons, valued at $89,618,000, based on the average selling price, as compared with 584,597 short tons, valued at $119,258,000, based on the average selling price, in 1917—a decrease of 92,192 tons, or nearly 16%, in quantity and of $29,640,000, or about 25%, in value.

Company Reports

CHILE COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Controls the Chile Exploration Co., with mine and mill at Chuquicamata, and power plant at Tocopilla, Chile.

Operating Officials: Burr Wheeler, general manager; B. Middlemiss, assistant general manager.

Financial: Operating revenue, $17,711,020.80; operating cost, $10,205,764.82; operating profit, $7,505,256.98; other income, $1,169,867.23; total income, $8,675,124.21; charges against income, including interest on bonds of Chile Copper Co., $3,590,280.18; balance of income carried to surplus account, $5,084,844.03; charges against 1920 surplus, $4,932,850.04; net surplus from 1920 operations, $151,993.99; net deficit as at December 31, 1919, $501,712.28; net deficit as at December 31, 1920, $349,718.29.

Development: No further prospect drilling has been done beyond that mentioned in the last annual report. The ore-reserves as at December 31, 1920, were: 329,306,106 tons of oxidized ore, containing 1.91%; 151,000,000 tons of mixed ore, containing 2.98%; and 210,000,000 tons of sulphide ore, containing 1.84%; or a total of 690,306,106 tons, with an average copper content of 2.12%.

Mining Operations: Total ground broken during the year amounted to 2,134,665 cu. yd.; 627,595 cu. yd. of waste was removed from the benches, averaging 0.30% copper; total number of churn-drill holes drilled amounted to 764, with a total footage of 34,477 ft.; the total advance in blasting tunnels was 5919 ft.; since the beginning of the underground blasting tunnel development, a total of 93,340 ft. has been driven, of which 38,651 ft. has been blasted, and 54,689 ft. remains. Five new-type 103-C electric-shovels are being erected; when these are in service there will be a total of 9 standard electric-shovels, 1 Type 225-B revolving electric-shovel, and 10 Type 95-B steam-shovels on the property. Six 85-ton Porter side-tank locomotives have been added to the mine rolling stock, making a total of 32. One 1050-cu. ft. motor-driven air-compressor was installed in March, making a total of three of this type in service at the mine.

Milling Operations: 4,243,301 tons was crushed; the oversize on a 0.371-in. square-mesh screen was 13.54%, as compared with 19% for the previous year.

Leaching Operations: 414 charges were treated during the year, the average extraction of copper being 91.9%, as compared with 88.5% for the previous year.

Electrolytic Operations: The new 96-cell circuit was completed in December. The plant is now equipped with 894 cells.

Melting Operations: The third melting furnace was completed and started operations in April. The total production of copper during the year was 55,565 short tons.

General: The power plant at Tocopilla is operated exclusively on fuel oil; from the beginning of operations the company has relied on contracts with producers, who furnished the transportation, and delivered the oil at destination. This has not proved satisfactory, with the result that, during September 1920 a contract was made with British shipyards for the construction of two modern tank ships, each of 70,000 bbl. carrying capacity. One of these should be delivered late this year, and the other a few months afterwards.

In furtherance of the policy of discontinuing plant extensions until the universal disorganization of business conditions has improved sufficiently to give promise of the probable continuous sale of a maximum production from the 15,000-ton plant, the present condition of the work is as follows: (1) Designing work has been discontinued; (2) the 18,000-k.v.a. turbo-generator set is under construction, the installation not being postponed, as it was needed to safeguard the power requirements of the present plant; (3) further work on leaching plant and sump construction has been discontinued; (4) the 55,000-bbl. fuel-oil tank at Chuquicamata has been installed, as an insurance against accident and to prevent irregular supply; (5) the water reclamation system has been postponed, there being ample water at the present rate of production.

HOWE SOUND COMPANY

Report for the year ended December 31, 1920.

Property: Company owns the Britannia Mining & Smelting Co., which owns the Britannia Power Co. and the Howe Sound Potosi Mining Co., which owns much of the stock of the Chihuahua Mining Company. Mines and mills in British Columbia and Mexico.

Operating Officials: E. J. Donahue, general manager Britannia company; A. L. Eaton, general manager El Potosi company.

Financial: Income, $7,024,330.14; expenditure, $5,177,167.00; balance forward, $109,753.63; dividends, $396,830; dividend payable January 15, 1921, $99,207.50.

Development: Britannia company, 7078 ft. together with 5446 ft. of diamond-drilling; El Potosi company, 20,095 ft. of diamond-drilling.

Production: Tonnage handled by the Beach Mill during the year amounted to 710,450; yield amounted to 18,161,854 lb. copper, 6495.58 gold, and 101,505.07 oz. silver. From the Mexican plant there was shipped during the year the following: 120,158 tons of lead carbonates, with 13.95 oz. silver and 4.22% lead; 42,211 tons of lead sulphides, with 19.34 oz. silver and 6.98% lead; and 11,441 tons of iron sulphides, with 23.38 oz. silver per ton.

General: The concentrating mill at Britannia Beach was completely destroyed by fire on the evening of March 19. The power-house and adjacent buildings were saved. The company is protected by insurance and the construction of a new mill will be commenced as soon as plans and specifications can be prepared.

AMPARO MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at Etzatlan, Jalisco, Mexico.

Operating Officials: J. H. Howard, general manager; W. Howard, assistant general manager; W. R. Askew, chief engineer; C. F. Joyce, mine superintendent; A. F. Dick-Cleland, superintendent. Exploration company: W. Alison, shaft superintendent; J. M. Brown, assistant mill superintendent.

Financial: Income, $1,748,381.59; profit on operations, $231,756.79; net profit to surplus, $114,416.91.

Production: 149,518 tons was milled, yielding 1,258,985 oz. silver, and 27,176 oz. gold. Operating costs showed a decline of $2.48 per ton, as compared with 1919.

General: The Merrill-Crowe system of precipitation was adopted during the year and is in successful operation. It is expected that the saving in the consumption of zinc and cyanide in a year will cover the cost of the change. The fineness of the bullion produced is also improved.

INTERNATIONAL NICKEL COMPANY

Report for the year ended March 31, 1921.

Property: Mines and plants in Canada; refineries in New Jersey.

Financial: Total income, $5,166,581.23; administrative and head-office expense, $987,731.25; net income, $4,187,849.98; profit for the year, $2,029,699.83; dividends, $534,756.

General: No technical details of the year's operations are given.

The Present Depression and Its Causes

By H. C. Hoover

*There is a feeling of some uneasiness and even of pessimism regarding the future of our foreign trade, in which I do not participate.

Our exports and imports during the last few months have dropped nearly 50% in value from the high-water mark of a year ago. Some of this decrease is due to the fall in prices relatively more than volume; some of it is the temporary world depression and some of it lies deeper.

In these times of troubled minds, we find much conflict of opinion as to the situation and its remedies. Some extreme groups insist that inasmuch as our exports comprise but 10% of our total production, therefore our foreign trade bears only this ratio to our economic life, and that, consequently, our true course is to forget it and to devote ourselves to healing our internal economic wounds. Other extreme groups consider that for our internal situation the only remedy is restoration of our export trade; they would undertake desperate measures to accomplish it. In either case we must not allow the present industrial depression to obscure our view. We have passed through several depressions since the Civil War and we have already turned the corner of this one.

The importance of our foreign trade requires but little defense. I may say in passing that our whole standard of living greatly depends upon our imports and that our exports are the great balance-wheel for our production. Exports are vital to the stabilization of our industries, of price-levels, of wages, and of employment. While our exports do cover but a small proportion of our total production, on the other hand they do comprise a large percentage of the production of certain industries. For instance, we generally export 20% of our wheat, 60% of our cotton, 75% of our copper, not to mention others. Unless we find a market for the surplus production of our great industries, we shall continue to keep some 25 millions of our people in reduced buying power. We might even drive them into poverty—during the many years that would be required to shift the whole basis of our internal production. Nor does a nation become rich by its exports alone—but by its trade.

While many of the causes of the present depression lie within our own borders, yet there may be no recovery from these hard times for many years to come, if we neglect our economic relations abroad. Even if we lower our vision of civilization in this crisis solely to our own selfish economic interest, we are yet mightily concerned in the recuperation of the entire world. The hard times that knock at every cottage door today came from Europe. No tariffs, no embargoes, no navies, no armies can defend us from these invasions. Our sole defense is the prosperity of our neighbors and our own commercial skill. The recovery of our foreign trade can march only in company with the welfare and prosperity of our customers.

When we analyze the present foreign-trade situation, we find tremendous shifts in economic currents since 1914. Indeed, we find great changes still in progress. If we would guide our policies of production and of trade aright, we must keep these great changes constantly in mind. These profound alterations naturally fall into two divisions: The shift in the world's production and markets and the shift in the world's financial relations. They bear upon each other, and they affect our three primary groups of food, raw material, and manufactured goods differently.

There have been great changes in our own economic situation. We have not alone shifted from a debtor to a creditor nation; our capacity for surplus production in food and manufactures has grown enormously during the War until we have taken front rank of the world in foreign trade.

The direction of our trade has shifted greatly. During the last year about one-half of our whole foreign trade was with Europe, but of our exports to them 80% were foodstuffs and raw material; of our exports to states outside of Europe about 75% were manufactured goods. Europe in turn is our serious competitor in marketing of our manufactured goods to the rest of the world. We have enormously increased our imports of tropical and other commodities that we do not produce.

Since the Great War, the world, outside the fighting states of Europe, has gained mightily in wealth, in standards of living, and in consuming power. Even omitting the United States, it has gained something like 40 millions in population. The countries not directly affected by the War are indeed suffering from the general depression, but this depression with them is only the aftermath of the malevolent forces born of the past war booms. They have none of the deep economic wounds of the fighting states, and they will be quick to recover. During the War the productive capacity of these states, except possibly Japan, had no unusual increase because of their isolation through shortage of shipping.

One of the economic shifts that affects the whole world profoundly is from Russia. Russia bore much the same relation to western Europe before the War that the Mississippi Valley bears to our North-Eastern States. Russia was one of the great food bases of the manufacturing countries of western Europe, exchanging food for their fabricated products. These manufactured goods in turn were to some degree produced from our raw materials.

*An address delivered on July 12 at Boston before the National Shoe and Leather Exposition and Style Show.

Even at best it will be many years before Russia will have recovered. We are today the only great source of enlarged food production. Europe must and will draw from us a great proportion of food-supplies that she formerly drew from Russia. I see no basic reason why we should not continue to export approximately the same large volumes of foodstuffs that we have exported abroad during the past 12 months. This item alone at even present prices would be triple our pre-war food exports, and would represent the equal of more than 60% of our whole pre-war export trade.

Another great but uncertain shift in world forces will arise out of Germany. The reparation payments must have a profound effect upon the whole economy of the world. Germany is to pay outside her borders to the Allies $500,000,000, plus 26% export-duty, or, say, a minimum of about $750,000,000 per annum. Germany is left without much gold or foreign property, or foreign business earnings of consequence; therefore, these payments must be made mostly by the sale of manufactured goods outside her borders. But beyond the reparation payments, she must also sell goods abroad in the amounts necessary to buy her imports of food and raw materials. Any calculation based on the pre-war trade of Germany implies an enormous increase—perhaps more than doubling—of her pre-war exports. In view of the export duty and other payments, she must produce these goods for about one-half our production cost in order to take our markets. Such an increase in exports must be manufactured goods, and until the world consumption grows, these must be marketed in displacement of the goods of other industrial nations. We shall certainly feel the effects of this flow of goods that must be produced if she is to make reparation payments. On the other hand, Germany must take more raw material from us for this purpose. In any event, the crowding in the market of German exports will affect her immediate neighbors more than ourselves, for 80% of her market, pre-war as well as in the future, must lie in Europe itself.

The economic changes in the other combatant states in Europe obviously affects us also. The economic wounds given to them all by the War and peace will be long in healing. The sacrifice of skilled labor, of brains, and of property will require a generation to cure. The hates of many newly liberated states must cool slowly, and their many new borders check the free flow of commerce. Many of these states possess masses of people who have suffered from exploitation and tyranny for generations. Their extreme reactions of Bolshevism and socialism and nationalization are slowly dying out. Many governments have been unable to raise sufficient taxes to meet expenditures, and the ceaseless printing of currency carries destructive inflation. All of them except the enemy states bear the burden of greater military establishments than even before the Great War. All this must accumulate to decrease their productive power and to lower their standards of living.

In balance against this loss of productive power, their people over great sections are now coming to a full realization that they must work harder than ever before and that they must export commodities for all that is in them, in order that they may make exchanges for the bare margin of life. Some of them will receive payments from Germany in relief of their tax-burdens. They are mobilizing the skill and intelligence of their people to their economic salvation with the same diligence that they were mobilized in war. The great manufacturing states are straining every device of science and thought to the improvement of their industrial processes, to the simplification of production, to the elimination of waste—that they shall make every reduction in production costs. In reinforcement of their marketing machinery, many of the governments are stimulating the consolidation of banks and of manufacturing concerns. Governmental and government-encouraged combinations are being created to control exports and imports to exploit foreign markets. They are seeking special concessions for development and trade throughout the world. Altogether these policies comprise a militancy in commercial expansion that compares with Elizabethan England.

Any improvement in European production of manufactured goods will favorably affect our market for those raw materials such as cotton and copper, where we possess the final supplies. In considering the demands for such raw materials, we must remember that the manufacturing countries of western Europe have lost for a long time to come any great markets in Russia and Turkey; the population of Europe as a whole has not the consuming capacity for manufactured goods that it had before the War and, therefore, we must expect less than pre-war consumption in the confines of Europe for their re-manufactured raw materials. But on the other hand, they will find, after this depression is passed, that the markets of the rest of the world are larger than before the War. I am confident they will gradually return to pre-war demand for our cotton, copper, etc. Fortunately, our producers have realized this temporary situation and have vigorously reduced their production so that they should eventually realize better prices than at present.

It seems to me that it was inevitable that the balance of the forces at work in Europe would improve their ability in competitive manufactured goods. Their production costs were bound to be lowered, both by better organized industry and by lowered standards of living. Some of them are today, through government subsidies, artificially low and will undoubtedly increase. If we analyze the effect of these forces on the market for our manufactured goods, either in Europe or in our much larger markets outside of Europe, we quickly find two directions in which we occupy a position of some security. The first is in those exports of lower production-costs which are the result of great repetitive production, which has its firm root in our enormous consumption. The second is in that large number of special manufactures in which the inventive genius and skill of our people have been developed beyond any country in the world. Your own industry of shoes and shoe findings is typical.

I believe we will recover and can hold our share of the market for these products after the present world depression.

As to our manufactures, containing a large element of labor cost, in which we do not enjoy special advantages, we must look out and take measures of our own. We can no doubt devise tariff measures that will protect our domestic market. But if we are to hold to our foreign markets in this vast group of our manufactures, and thus keep our people employed, we have several things to attend to. Fundamentally, we must get our production costs down. That lies only along the road of increased efficiency in our whole industrial machine. It means a willingness of our working people to put forth every effort that is in them, consistent with health, proper family life, and good citizenship. The surest road to a continued high wage, and the surest safeguard against unemployment, is to remove every restriction on effort. This must extend from our mines to the railways, to the factories, to the wharf, and to the ship. It means smaller margins of profit. It means that ultimately we must have much lower transportation rates. It means we must have better organized marketing machinery abroad under Americans themselves. It means the establishment of adequate short-time-credit machinery and much more care in foreign-credit risks than our merchants have shown in the last 12 months. It means elimination of the great wastes in industry. For instance, in the Atlantic seaboard area alone, by the development of these great water-powers and through economies by electrification generally, we could profitably save 30,000,000 tons of coal per annum if we had the courage to go at it. It means the Government must remove as quickly as possible those unnecessary domestic burdens upon commerce to which the Government is a party, by the reorganization of our tax system, the settlement of the tariff question, the reduction in Government expenditure through the reorganization of the Federal government, through reduction of armament and through reduction of Shipping Board losses and by the settlement by the Government of the outstanding claims of our railways. It means we must cease trying to drive American shipowners off the sea with tax-paid shipping losses. We must carefully determine what particular trade-routes we will maintain in development of our commerce over a period of years, and let our merchants know them. It means the Government must provide such information to commerce and industry, from both at home and abroad, as will enlarge its judgment. It means we must extend scientific research into the problems of waste, the perfection of processes, the simplification of methods that are beyond the ability of one manufacturer acting alone, and we must co-operate with industry to perfect these things. I am confident we can hold our markets, our higher standards of living and of wage if we will all put our backs into it.

Overriding all these questions of production and markets is one of credits. Our whole financial relation to the rest of the world has greatly shifted. From a nation owing some five billions of dollars to the rest of the world for moneys borrowed, the War has reversed our position so that the world, principally Europe, owes us today 13 to 15 billions of dollars, of which about 10 billions is due our Government. Before the War we had to export a surplus over our imports, and beyond this had to contribute, through remittances of immigrants, tourists, shipping, etc., great sums to pay interest upon our debts.

The reason for the piling up of this vast debt is, of course, that we have not only loaned money to the Allies, but have also since the War vastly increased the surplus of our exports, and the movement still continued to accumulate in our favor. Unless we would cease a large part of our war productivity with all the resulting unemployment and losses of such a cessation, we must continue to export in excess of our imports. Eventually the increase in our imports of tropical supplies, minerals, and commodities that we do not ourselves produce, together with the spending of tourists and the investment of surplus capital abroad, etc., should overtake our export balance and establish a proper equilibrium. In the meantime, if we would maintain our economic position, we must continue to give credits to buyers of our goods and if we should demand interest or principal on our established loans we would nullify any benefits of such credits. I may repeat that if today we stop giving more credits and demand payment of interest on debts due our Government, our exports will further decline, and the decline will find its interpretation in more unemployment among our own people and more displacement of our industries.

The natural effect of our continued surplus of exports is that our dollar is at a premium over even the most stable currencies in the world. Thus the cost of producing our commodities is higher than in any other country. This does not so materially affect the export of those commodities of which we hold a final supply, such as the food supplies and our raw materials, or those articles in the manufacture of which we have unique ability. It does, however, partly blockade our exports of manufactured goods in which we directly compete with Europe. Exchange itself is not the cause but the effect. It bears the same relation to trade that the barometer does to the weather. It is but an indication of the movement of commodities and credit. Our high barometer means we need more credits outward or alternatively we must send less goods out or take less goods in.

I may say, in passing, that I am confident that our debtors can eventually carry the debt due us with ease, provided they have the time necessary for the healing of their economic wounds, that they succeed in the reorganization of their fiscal policies so as to balance their government expenditure, and above all, that they secure disarmament and continued peace. Before the War the world carried a debt to a single European nation of twice the size of our foreign claims without knowing it, and with renewed growth of the world's commerce and wealth our debt will be no burden. Our problem is the difficul-

ties of our debtors during the few years until these blessings are attained.

My optimistic view that we will maintain the flow of our goods is based upon the assumption that we can wisely manage these credit problems. There is a general agreement that we must extend credit if we would market our surplus and upbuild our customers during these next few years of readjustment, but as to the methods there are many minds; there are those who would directly try to stabilize exchange back to parity; those who would create securities jointly guaranteed by the principal nations, either through international banks of issue, bonds, or currency; those who would extend credits directly or indirectly from the United States Treasury to buyers of goods, in order to stimulate exports; and also those who have confidence that the processes of business will find their own way out.

Attempts to bring exchange to parity or to create international securities of any kind are open to the objection that they involve an element of inflation and that they practically open the gates of credit from the United States without regard to risk, how its purpose affects us, or whether it really benefits the borrower. Loans from our Government direct to foreign governments or foreign merchants have a hundred objections and disagreeable entanglements which we learned well enough during the War. In all this maze of difficulty and the unsettlement over credits and debts, I would sum up that wisdom consists in knowing what to do next rather than debates upon perfection.

As necessary as the continued establishment of foreign credits are, if we are to maintain our large volume of export-trade, we should not over-estimate the amount needed for legitimate trade for re-finance and for reconstruction purposes. The amount is not so great as popularly supposed and will annually decline. I believe all trading states of consequence in the world can even now finance their imports of food-supplies. The stronger of them can finance their imports of raw materials. We are, indeed, importing very much larger quantities of tropical produce than before the War and our own consumption of these commodities will continue to grow. The margin of credits needed beyond our imports in order to keep commerce alive for the present are, first, comparatively short-term amounts to cover part of our exports of raw materials and the distribution period of our manufactured goods, and, second, constant re-finance of debts or interest already owed to us.

In summary, on the production and marketing side of our commerce, we can say that our food exports should remain on a greatly enlarged scale; that the demand for our raw materials should slowly increase toward pre-war amounts; that in respect to our manufactures we should be able to hold special fields of repetitive production and ingenuity; that we will need to make a fight to hold the markets for manufactured goods where we come more directly into competition with the European manufacturer, but that we can do it if we will work and apply our brains to it. On the financial side of our situation, I do not believe our world credit situation is unsurmountable or that it requires extraordinary solutions.

I may repeat that we need to realize above all things, that even if we lower our vision of civilization in this crisis solely to that of our own selfish economic interest, we are mightily concerned in the recuperation of the entire world. There is an economic interdependence in the world that recognizes no national boundaries. The greatest jeopardy to the standard of living of our people is the lowered standards of Europe. Now that we have become a great debtor nation, we must learn that this great debt must be wisely directed so that we do not stifle both our own growth and the growth of others.

There are, indeed, many complexities arising out of our great expansion on productive power and our suddenly born creditor position. I do not need to say that we are confronted with a hundred difficulties, that we must be alert to steer our commercial policies against the winds of the world in an economic storm. We are suffering greatly in this immediate world-wide industrial depression. This depression is partly due to the War; it is partly due to our post-war boom, with its speculation, its extravagance, and its slackening of efficiency. The Government can help recovery by removing the obstructions to commerce and industry. But when all is done, the real cure for all depressions is courage and applied intelligence and the return to primary virtues of hard, conscientious toil and economy in living. On every side there is evidence that the vast majority of our whole nation is making again an effort in those directions equalled only by that of 1918, and the day some months ago when we entered this effort we fundamentally turned the corner of this depression.

We are not a nation of machines, and houses, factories, and railways. We are a nation of men, women, and children. Our industrial system and our commerce are simply implements for their comfort and happiness. When we deal with those great problems of business and economics we must be inspired by the knowledge that we are increasing and defending the standards of living of all our people. Upon this soil grow those moral and intellectual forces that make our nation great.

THE most active mining companies in the Belgian Congo are the Société Internationale Forestière et Minière du Congo, familiarly known as the Forminière, in which one-quarter of the capital is American-owned, and the Union Minière du Haut-Katanga, the ownership of which is divided between Belgian and English capital, states a consular report. The former is capitalized at 16,000,000 francs and the latter at 15,000,000. The Forminière specializes in extremely profitable diamond extraction. The Union Minière controls high-grade copper deposits. A mining enterprise independent of the Société Générale is the Géomines (Cie. Géologique et Minière des Ingénieurs et Industriels Belges), founded in 1910 by a combination of Belgian promoters and industrial engineers. Its concessions cover valuable deposits of gold, tin, and coal.

NEW FLOTATION PLANT AT THE SMUGGLER UNION MINE IS TREATING 700 TONS PER DAY

The new flotation plant of the Smuggler Union Mining Co. at Pandora, Colorado, recently started, is a $500,000 fireproof steel and concrete building, equipped with the latest and best machinery known to the milling science. This plant is making a rich concentrate, which will soon pay for its erection. The capacity of the new plant, when entirely finished and all machinery running smoothly, will be larger than the one destroyed by fire in June 1920, by several hundred tons per day. The output is now about 700 tons daily and the machinery yet to be installed will raise it to 1000 tons each 24 hours.

The new plant uses the flotation process. It was designed by Walter L. Reid, the former superintendent, after repeated tests. The ore milled or finished in the plant will be drawn from three large properties: The Smuggler group of mines and the Humboldt in Marshall basin, and the Black Bear mines in the north fork of Ingram basin. Concentration and amalgamation is being carried on at the same time, as both the Smuggler and Bear veins carry gold, and the concentrates are rich in silver, lead, iron, and copper. The plant, which is designed for the treatment of complex ores, comes as near solving the problem as any mill in the country at this time. With this plant in operation in addition to the Tomboy and Liberty Bell, the ore shipments from Telluride will be larger than at any time in its history.

NEW GOLD DISCOVERY NEAR ANCHORAGE, ALASKA

Deposits of gold quartz reported to assay $100 per ton have caused a rush to the district 39 miles south of Anchorage. The first find was made at Girdwood, on the Government railroad. Subsequently a dozen goldbearing lodes were uncovered within an area of about 5 by 7 miles. Some of these were exposed in the railroad cuts along Turnagain Arm. Engineers, who made a preliminary investigation, believe that the discovery is one of immense importance, according to dispatches.

BRITISH COLUMBIAN'S PROTEST AGAINST CANADIAN TARIFF REGULATIONS

Disadvantages under which the metal industry of British Columbia is laboring because of the "inconsistencies and injustices" of the present tariff on metals and minerals entering Canada are pointed out in a memorial prepared by the Board of Trade of Trail, B. C., and forwarded to the Canadian Minister of Finance.

Referring to the wire-rod business it is set out that this material now is imported free of duty "when manufactured by the importers in their own plants". If this situation is continued it is argued that the Trail smelting plant, capable of producng 15,000 tons of copper rods per annum, is placed under an unfair handicap. It is asked that rods be protected to the same extent as ingot copper, namely, 1½c. per pound. Without this "there is no chance of the expansion of the refining industry in British Columbia, and Canada will continue to pay foreign plants for refining copper used in making rods for Canadian consumption, as well as for rolling the copper into rods after refining". The extension of the copper schedule in the tariff to include scrap copper also is sought because for many purposes it is as good as virgin; a great deal of that left in connection with munition manufacture had been dumped into Canada, and that this might be expected to continue in a lesser degree in the future. Scrap zinc and scrap brass, it is contended, should be subjected to a duty for similar reasons.

INCREASED PRODUCTION OF GOLD IN ONTARIO

According to preliminary estimates the gold mines of Northern Ontario produced approximately $1,350,000 during the month of June. This compares with estimates of a little under $1,300,000 in May and $1,084,345 in April. The production for the second quarter of the year, therefore, amounted to around $3,734,345 and is the highest quarter in the history of gold mining in Ontario. This compares with $2,953,036 during the first quarter of the year, during which time the mines were handicapped through lack of hydro-electric power. In spite of this difficulty the first quarter of the year, the half-year just closed resulted in an aggregate gold output of approximately $6,687,381. There is the additional important fact that the second half of the year has commenced with gold being turned out at the rate of at least $1,350,000 per month, which would indicate a production of $4,050,000 for the quarter that includes July, August, and September.

RICH PLACER DEPOSITS IN NORTHERN MEXICO

Ralph L. Van der Naillen has returned from Mexico with sundry valuable concessions granted by President Obregon and glowing reports of the prospect for developing and exploiting rich gold-placer deposits along the rivers of northern Mexico. He is quoted as saying that he explored the Sinaloa river for more than 200 miles, finding gravel of "paying" grade so abundant as to tax "human credulity". On the Fuerte river he found gravel that equaled the richest ever found in Nevada and Butte counties in California. Van der Naillen declares that the Mexican government, as regards himself, had acted in the highest good faith throughout his negotiations.

AGREEMENT TO ARBITRATE ENDS STRIKE AT GRASS VALLEY

The strike and lockout of miners in the Empire, North Star, and Idaho-Maryland mines at Grass Valley ended on July 15 when the Mine Workers' League voted to accept arbitration and the miners returned to work. Resumption is proceeding as rapidly as possible. The mines were practically closed on July 1 when the miners refused to accept a reduction of $1 in the daily wage-scale and only pumpmen and engineers remained at work. The League at that time censured the mine operators for announcing the new wage-scale through the press before giving notice to the workers. A 50c. cut would have been acceptable, the League voted later, and, when the companies refused to accede, a threat was made to withdraw the pump-men and hoist-

engineers. Both sides had been determined not to recede from their original stands, and it was only after arbitration was agreed upon that the miners decided to return to work. An arbitration board to represent the operators and the more than 600 workers will be named and their award will become retroactive to July 1. The loss of miners' wages due to the strike is estimated between $60,000 and $70,000.

ARIZONA

Globe.—Water, to the amount of 660,000 gal. per day, is to be furnished the city of Globe by the Old Dominion Copper Mining & Smelting Co. at a charge of 12½c. per 1000 gal. Eight thousand feet of 8-in. supply main will be built from the mine to connect with the city mains. The city water-system, on which $400,000 has been spent, has proved inadequate in present drought conditions. Water from the mine is better than that from the city wells.

CALIFORNIA

Auburn.—The shaft of the Rising Sun mine, near Colfax, is to be deepened and exploration at lower levels started. During 1920 a new hoist, compressor, and pumps, together with a 10-stamp mill and two concentrators, were installed. The mill operated for five months, but the ore on the upper levels has been exhausted. New development will be commenced at once.——George Carmack is erecting a drill on his property, formerly known as the Pacific Blue Lead mine. He has been prospecting the claims for two years, and has recently decided that a drill is the most economical machine for continuing the work.

Bridgeport.—An important mining transaction is the transfer of the Success and Success No. 2 claims, under bond and lease, to Elmer M. Green. John H. and C. C. Hayes, who have been prospecting the claim, found considerably high-grade ore, but were unable to finance the opening of the property on a large scale.

Lewiston.—L. Gardella, of Oroville, is making rapid progress in the construction of his dredge which will work the goldbearing ground on the Paulsen ranch, which Gardella recently purchased.

Melones.—In June the Carson Hill Gold Mining Co. milled 15,500 tons of ore, an increase of 300 tons over May and the highest monthly crushing since beginning operations. On the surface just back of the present workings in the Morgan mine, the company is mining, by glory-holing, a deposit which years ago returned over $3,000,000 in pockets of free gold. It is producing 125 tons of ore per day from this operation, at a cost, including everything, of $2.50 per ton, and the ore averages between $4 and $4.50 per ton.

Quincy.—Harry Barnes has uncovered an 8-ft. vein of high-grade bornite ore at a point 14 ft. below the surface in a prospect shaft on his claim near the Engels mine.——The Reinmiller Copper Co. is preparing to do additional prospecting by means of diamond-drills. Since last fall the company has proved the existence of three distinct orebodies in its property north-west of the Engels mine.——Diamond-drilling on the property of the Feather River Copper Co. has disclosed various bodies of high-grade copper ore containing both bornite and chalcopyrite. Ore also has been found in the main working-tunnel, approximately 2000 ft. long. H. E. Bush is manager of the property.

Redding.—An aerial tram is being constructed to connect the Hornet mine of the Mountain Copper Co. with the Southern Pacific railway. The lower terminal of the tram will be at the new town called Mathewson, the name being that of one of the directors of the company. Eventually the Iron Mountain railway, which now carries the ore, will be abandoned. The company is building a first-class highway from the mine to Mathewson, so that cumbrous freight, that cannot be moved on the tramway, will be hauled by auto-truck. Lloyd C. White is the designer of the tramway. The company has petitioned the Board of Equalization of Shasta county to reduce the valuation placed on its Iron Mountain mine, for purposes of taxation by the county assessor. The Iron Mountain mine is distinct from the Hornet property.

COLORADO

Aspen.—Development of the orebody opened in the Hope tunnel is progressing. A second raise is being driven 35 ft. south of Raise No. 1, and an orebody 5 ft. wide assaying 25 oz. silver and 25% lead is exposed. Native silver is present. A larger force of miners is to be employed; a concrete boarding-house is under construction.

Breckenridge.—A find of silver ore in a vein 18 in. wide has been made at the surface on the June Bug. Three tons taken out by trenching assays around 400 oz. and a 2-in. streak 1000 oz. per ton.——The concentrator at the Pennsylvania mine of the Liberty Leasing Co. at Argentine has resumed. Ore is hauled to the plant by auto-truck.

Cripple Creek.—The June output from the Cripple Creek district, curtailed by cessation of freight-traffic by the railroads during the flood period, totaled 36,381 tons, with average value of $10.02 per ton and gross bullion-value of $365,171. Of this tonnage the Golden Cycle mill, that has treated all ores shipped from the district since the shut-down of the Pueblo smelter, handled 22,000 tons with an average value of $14, total, $308,000; Portland G. M. Co.'s Independence mill, 13,181 tons, $4.20, total, $55,371; and Lincoln M. & R. Co.'s mill, 1200, $1.50, total, $1800.

The Queen mine in Eclipse gulch, owned by the Queen Gold Mining Co., controlled by the John T. Milliken estate, is to resume operations. The shaft is to be sunk an additional 250 ft. to the 950-ft. level and arrangements made to cross-cut the ground on the level of the Roosevelt deep-drainage tunnel, at about 1700 feet.

Georgetown.—The Capital Mining & Tunnel Co., while not operating on company account, is planning to start up its compressor plant to furnish air to lessees. One set in Bruce territory has opened up a rich shoot of lead-silver ore, and a shipment sent out last week is estimated to be worth $100 per ton. The pay-streak is 18 in. thick of nearly solid metal.

Leadville.—Due to the closing down of the Pueblo smelter the Arkansas Valley smelter is arranging to blow-in a fourth furnace.——Activity is reported from the Twin Lakes section. The Fidelity G. M. Co. operating the Fox property at the head of Black Cloud gulch has opened a 6-ft. vein from which the ore is averaging around $80 per ton, chiefly gold. A streak in the vein samples 10 to 15 oz.; this ore is closely sorted and sacked.——Operations have been resumed on the Livermore in Red Cloud gulch, and on the Texas Creek holdings of the Yale Mining & Utility Co. The Harland mill at Twin Lakes has been purchased by this company and is now being remodeled and new machinery installed.

Silverton.—The Ariadne Corporation, Alfred B. Iles, managing director, has resumed work on the Ariadne in the Cement district, five miles from Silverton. The property has been under continuous development for two years past and silver orebodies are developed. Shipments will commence as soon as a graded trail can be made to the mine. An aerial tram is to be constructed for movement of ores to the shipping point on the railroad.

Ward.—Electric power has been installed at the Ogden mill on the American Gold & Platinum Co.'s property. Tests of the 'Ogden' process are reported to have made high recovery of the fine gold and platinum in the company's ores.

IDAHO

Coeur d'Alene.—In the Sterling Silver property on Big creek the lower cross-cut tunnel has been driven nearly

600 ft., passing through several stringers of quartz carrying silver.——According to Charles G. Taylor, manager for the Giant Ledge Mining Co., half a dozen mines will be added to the list of shippers from the Coeur d'Alene just as soon as the reconstruction of the railroad up Pritchard creek is completed. The reconstruction of the road will reduce the haul from Bear creek considerably. In about two months the Paragon will be ready to operate. It is 16 miles from a railroad, but will be within two miles of the line when rebuilt. The Jack Waite is a shipper in spite of its long haul, which will be eight or ten miles less when the road is built. The Monarch has been hauling its concentrates 15 miles. The railroad will be at its door. The Giant Ledge will in all probability finish its mill this fall and will be ready to commence shipments.

At a meeting of the American Commander Mining & Milling Co., recently held at Wallace, the following board of directors was elected: Patrick Johns, New York; J. A. Glowe and Harry Kingsbury, Mullan; and J. L. McCormack and Herman Marquardt, Wallace. Operations in the tunnel have been suspended while machinery is being installed. Two or three feet of carbonate ore was exposed when work was suspended in a drift from the upper tunnel.

The lessees of the Western Union Mining Co. have shipped ore having a gross value of $54,454 since November 19, 1920, according to reports recently made by the board of directors.——The Sidney mine on Pine creek in the Coeur d'Alene has started shipping. More than 175 tons of high-grade ore has accumulated during the exploration of the vein for a distance of 240 ft.——It is now believed that the Imperial Mining Co. has found the vein for which it has been searching. The cross-cut was run 500 ft. without striking anything that looked like the vein, although several stringers of good ore were cut. Recently the management went back 200 ft. from the face of the cross-cut and started to drift west on a promising looking stringer. In 15 ft. the stringers widened out to four feet of vein with crystallized lead scattered through it. Assays from some of this ore returned 26.7% lead.

MICHIGAN

Houghton.—Copper continues to move out of the Lake Superior district. One steamer has just taken a cargo of 900,000 lb. of Calumet & Hecla, Copper Range, and Quincy metal, half from each smelter. This shipment included 300,000 lb. of Calumet & Hecla copper for domestic buyers, business previously reported.

At the Quincy smelter preparations are being made for the overhauling and modernizing of No. 3 furnace. It will be enlarged to a capacity equal to that of No. 5, or 150,000 lb., which will give Quincy two of the largest and most modern furnace-units in the district. No. 5 furnace is just about completed. It has been partly in commission for some time. Like No. 5, No. 3 will be served by automatic casting-machines, electric cranes, and trolley dipping system, which will result in a lessening of operating costs and greatly increase Quincy's capacity to meet any unusual demand for metal. Quincy is not smelting as much ore as is being shipped to the smelter and large quantities are being accumulated. Quincy's refined metal stocks are low, the smelter output keeping just a little ahead of demand. Quincy continues to yield a lot of mass copper. No. 2 shaft is still the largest producer of mass. No. 6 and 8 also are notable in this respect.

But little timbering and few repairs have been necessary in the Osceola property since its shut-down. In the North Kearsarge branch electric pumps are now handling the inflow of water from the Wolverine. Three pumps are in operation, one on the 17th level, one on the 31st, and one on the 36th in No. 1 shaft. A number of small pumps formerly in use in No. 3 shaft have been stopped and it is no longer necessary to use No. 1 shaft for bailing purposes. The use of electric pumps will greatly lessen mine-costs in this branch. Costs took a jump when Wolverine stopped pumping in the lower part of its mine in May of last year, necessitating an opening between the two properties in order that the water might be pumped through North Kearsarge.

Preliminary work on the draining of a dam near No. 2 shaft of the Allouez mine has been started by Calumet & Hecla. The water has been seeping through into the mine, adding to pumping troubles. A ditch, a half mile in length and 10 ft. in depth, also will take care of surface water that has been getting into Ahmeek and Kearsarge. A large dredge employed by Calumet & Hecla in draining territory west of the South Hecla shafts will be used in this work. It is surface water that gives the most trouble and the drainage ditches will result in a considerable reduction of costs. Calumet & Hecla has successfully drained a swamp several miles in extent to the west of the South Hecla branch, taking care of water that formerly found its way into the conglomerate shafts, burdening the pumps and necessitating the operation of bailers.

MONTANA

Butte.—Development on the 2300-ft. level of the Colorado mine by the Davis-Daly company indicates a large body of copper ore assaying 15 to 16% copper. The vein continues to be from five to six feet wide. At its Hibernia mine the company is sinking the main shaft from the 600 to the 800-ft. level.

A two-foot vein of good silver ore is being followed by the Butte & Plutus company on the 400-ft. level. The ore is believed to be part of the Norwich vein system.

Dillon.—According to Henry Auerbach, president of the Silver Spray Mining Co., the necessary capital has been raised for resuming work at the property 20 miles southeast of here. A hoist, compressor, and other necessary machinery will be provided to sink the shaft below the 80-ft. level.

Elkhorn.—Additional men are being employed by the Boston & Montana company in the erection of its 1000-ton mill. The large gyratory crushers that will do the original crushing have arrived at the plant.

NEVADA

Cherry Creek.—Joseph Whitford is operating the North Mountain and Wild West mines under lease from Thomas Ogers and others. Two shipments of ore recently sent to the smelter at Midvale, Utah, netted $4000. Plans are being made to operate a five-stamp mill.——Herman Bress and Charles Johnson shipped five tons of gold-silver ore assaying $68 per ton.

Ely.—The Boston & Ely Consolidated Mines Co. is steadily developing copper ore of smelting grade on its property one mile west of town. The main workings of the Boston & Ely company, on Ely Northern ground, consist of a tunnel driven 636 ft. north from the canyon and of about 500 ft. of cross-cuts driven from it in the copper-bearing limonite body which was entered at 420 ft. from the portal. A 420-ft. shaft was sunk 290 ft. to water-level, and four levels driven from it at the 50-, 100-, 200-, and 280-ft. points. A raise above the shaft was driven 150 ft. to the surface. The total development to date amounts to about 2700 ft. The mine is equipped with semi-Diesel compressor, hoists, and other machinery.

In addition to the discoveries on the Boston & Ely on ground originally owned by the Ely Northern company, considerable bodies of zinc, lead, and copper ores are now being developed on ground owned by the Ely Calumet company, operated under a lease by A. D. Meyers and associates. This ground is situated about a mile and a half east of the Ely Northern claims.

The Board of Examiners for hoisting-engineers has

issued first-class licenses to six applicants. The former practice was for the person seeking a license to operate a mine hoist, to make written application to the Board of County Commissioners, filing therewith an affidavit as to his past experience. The new law requires him to appear before the Examining Board in person and demonstrate his ability to operate a hoisting-engine.

Goldfield.—The first shipment of high-grade ore from the Donald and Giles lease on the Florence contained 1900 lb. assaying 142½ oz. gold per ton, with a small silver content. The ore is widening slightly as a stope is advanced above the 110-ft. level of the Reilly workings. After more than 15 years the work of Donald and Giles brings to light how Ross Woodward, now leasing in an adjoining block in the same vein, actually shot into the Donald and Giles orebody, which would have led him to the Reilly bonanza, and missed it because he did not sample the ore. Woodward then abandoned the block and it was leased by Reilly, who made a production that was estimated at more than $500,000 gross. Woodward drifted for 20 ft. parallel to the Donald and Giles shoot and within 18 in. of it. He drilled two "pop holes" into the side of the drift and these holes, it is now revealed, entered the ore, and Woodward could have had a fortune had he panned the broken material.

Hornsilver.—A. I. D'Arcy of Goldfield and San Francisco associates have signed an agreement to buy for a price reported to be $50,000 the lease of J. W. Dunfee on the Orlean mine, and have acquired Dunfee's option to buy the property for $40,000. The Orlean contains at a depth of 380 ft. from the surface, or on the 580-ft. level of an inclined shaft, what is considered to be the most important orebody found in southern Nevada since the early days of Goldfield. The shoot, 5 to 15 ft. wide, is 130 ft. long as exposed now and there is no indication of the end. The average value of the ore is more than $30. The plan of Mr. D'Arcy, it is said, is to block out the ore and erect a mill after this has been done, using the organization of the Columbia Divide in financing the project, and later changing the name to Columbia Hornsilver. The orebody on the 580-ft. level is one of two important shoots exposed in the mine, the other being on the 200-ft. level of a second shaft. This orebody, 100 ft. long, is reported to have an average value of $20.

Stonewall.—The Yellow Tiger has moved from Goldfield one of the 30,000-gal. water-tanks formerly used by the Goldfield Consolidated. This will be used by the Tiger for the storage of oil for that and other companies in the surrounding region. The cost of Diesel-grade oil can be reduced from 27½ to 10c. per gallon by buying in large quantities, according to Gordon M. Bettles, manager.

Virginia City.—A transformer-house at the Belcher mine in Gold Hill was destroyed by fire recently. The fire will delay work on the Belcher mine of the United Comstock Mines Co. The Belcher shaft is one of the four through which the United Comstock company is operating and the delay will come through the shortage of electricity until repairs are completed.

UTAH

Alta.—According to M. R. Evans, manager of the Columbus-Rexall company, during the two weeks period ending July 9, 63 carloads of ore were sent to the Midvale smelter. The first lot, consisting of 141 tons, gave net smelter returns of $4005. All of this ore was mined during the past winter, and stored at the property. Physical conditions in the mine are satisfactory.——At the Wasatch Mining Co.'s property 25 men are employed.——The South Hecla Mining Co. is now shipping an average of 50 tons of silver-lead ore per day, according to George H. Watson, manager.

Eureka.—Most of the mines in this district closed for three days—July 3, 4, and 5—to give their employees a holiday. Shipments for the week ending July 9 totaled 156 carloads, or approximately 6260 tons. The Tintic Standard shipped 47 cars; Chief Consolidated, 36; Grand Central, 12; Iron King, 9; Eagle & Blue Bell, 8; Victoria, 7; Iron Blossom, 7; Swansea, 8; Colorado, 8; Dragon, 6; Eureka Hill, 2; Mammoth, 1; Yankee, 1. During the same period the Tintic Milling Co. received 28 cars of ore from the Horn Silver mine at Frisco, Utah.

During the current year the mines in this district will be called upon to pay over one-half of the total taxes of Juab county. The valuation of real estate, personal property, etc., is $8,176,114, while the valuation placed on the mining companies, which includes their net proceeds, totals $8,727,181, making the total assessment for the county $16,903,295.

A well-equipped surface plant has been installed at the Diamond Queen property, consisting of a 60-hp. boiler, an Ingersoll-Rand compressor, and a hoist. A bunk-house, boarding-house, and office building have been completed. The shaft is now at a depth of 180 ft.; it will be sunk to 500 ft. according to Richard Campbell who is in charge of the work.

E. J. Raddatz, general manager for the Tintic Standard company, announces that two new roasters are to be installed at the company's mill in Warm creek. A tonnage of 140 tons is being handled by the seven roasters now in operation at the mill. The two new roasters will make possible the treatment of 190 tons. This can mean only one thing—that excellent work is being done at the plant. About 14 oz. silver, 3½% lead, 2% copper, and some gold is contained in the ore now being sent to the mill. A shipment of 18,700 oz. of silver bullion was sent to the mint recently from the mill, and since then two shipments of bullion have been sent to the Salt Lake smelters for refining, on account of the repair work being done at the mill refinery. Each of these lots contained about 22,000 ounces.

Tooele.—Announcement is made that work will be resumed at the Buckhorn mine, about 50 miles west of here, in the Dugway mountains. The directors feel confident that the source of the rich gold-silver ore found on the surface years ago by Sam Gilson will be discovered. It is stated that the ore shipped from this property by Gilson and his associates during the summer of 1891 was some of the richest ever discovered in Utah. The ore was principally a chloride of silver, with some free gold found in the matrix. Shipments made at the time are said to have averaged from $200 to $1100 per ton. On account of its inaccessibility, the property has remained idle all of these years.

WASHINGTON

Northport.—Success is attending the efforts of Harris & Coring in their development of the Gus Macki zinc deposits. The shaft has been sunk 180 ft., disclosing a continuous vein. Several carload shipments have been made and a concentrator is being installed for the separation of the lead and zinc. Macki discovered zinc-carbonate ore on his farm by accident in the course of plowing. The vein has a maximum width of 7 to 8 ft. and at the surface its chief metallic content is zinc. Lead has appeared in increasing volume as depth was attained. The ore is reported to contain 40 to 50% zinc, some lead, and four to five ounces of silver per ton. The property was acquired a year ago on a bond and lease for $30,000.

Republic.—The Lone Pine and Surprise mines, at Republic, owned by the Day Brothers, shipped 15 carloads of ore, or about 450 tons, in June, and 30 tons is being mined daily. The San Poil mine, in the same district, is shipping 50 tons of ore per day.——It is reported that the Day interests are to develop their properties to a greater extent

than ever before and that they will erect a plant for the treatment of their own ores. There also is talk that a custom-plant is to be built for the district.

BRITISH COLUMBIA

Alice Arm.—The Consolidated Homestake Mining & Development Co. has started to develop the Homestake group, on the upper Kitsault river. A body of low-grade ore, carrying copper, gold, and silver, has been exposed on the surface, and it is purposed to develop this at depth. The work is in charge of C. H. Gerhadi, who is now establishing a camp on the property. This property was bonded some years ago to the Granby company; drilling and other development work was done, but at that time the Dolly Varden railway had not been built, and the Granby company officials considered that the development did not warrant purchase, owing to the lack of transportation facilities. Like the Dolly Varden, to make a profitable mine under normal metal-price conditions, a concentrating plant will be necessary.

Gerrard.—The Provincial government is building a wagon road through Fire Valley for the purpose of opening the promising mining district in the neighborhood of Lightning Peak. At the Waterloo mine, in this district, some high-grade silver-lead ore has been developed.

Kitchener.—The tunnel at the Sullivan Larson group is being pushed forward, and it is expected that the orebody will be cut within the next two months.——A pump driven by gasoline engine has been placed in the shaft at the Leadville group, on Goat river and Leadville creek. The mine is said to be developing well.——Work has been started on the C. P. Hill claims, in the mountains near here; development is in charge of G. A. M. Young and W. R. Muir.

New Hazelton.—W. G. Norrie Lowenthal of the Delta Copper Co. says that the company will make no attempt at production during the existing conditions of the copper market, but the development of the mine is to be continued, principally by diamond-drilling. A drill for the purpose was taken to the mine last September.——It is understood that the Silver Standard mine, which has been the principal producer of this district, will not be re-opened this year, unless there is a marked improvement in the prices of silver, lead, and zinc.

MEXICO

Durango.—John A. King has filed on the old La Aguilarena gold-silver mine which comprises twelve claims in the Santiago Papasquiaro district.——P. de la Pena and associates are erecting a reduction plant near the station of Patos for treating the ores of the mines in that vicinity. It will be completed and ready for operation within a few weeks.——General Miguel Leveaga of this city has recently taken over the San Andrian mines; he is preparing to develop them.——A. R. Hunter has taken possession of the San Juan silver mines in the Santa Maria mountains at Velardena and is putting them in shape for production.

Mexico City.—According to an official government report, the production of different minerals in Mexico for the twelve months ending June 30, in kilogrammes (2¼ lb.), was: gold, 23,370; silver, 2,068,938; copper, 46,056,900; lead, 121,434,066; zinc, 14,363,057; mercury, 77,229; antimony, 1,572,376; graphite, 2,911,529; tungsten, 34,917; tin, 1588; arsenic, 1,198,806; and manganese, 838,624. The average monthly production of gold is placed at 1965 oz., and that of silver at 170,824 ounces.

Guanajuato, Mexico

One of the remarkable phases of the mining situation in Mexico at this time is that there are nearly 30,000 mines subject to forfeiture by the Government for non-payment of taxes. Forfeitures of this kind are being constantly made and many valuable properties have been acquired by new denouncements for a 'mere song'. It is shown by the records of the Bureau of Mines that there are approximately 70,000 mines in Mexico, including developed and undeveloped properties. Many of these mines were owned by Americans and other foreigners who were forced to seek safety by leaving the country during the revolutionary period. It is only recently that many of them have ventured to return and resume work upon their respective holdings. In many instances the owners of promising prospects have been unable

financially to meet the tax assessments against their mines and have been compelled to witness their forfeiture.

Saltillo.—Antonio Mazatan, of this city, is exploring the Parrena group of mines situated near the village of Parras in the Atajo mountains. It is practically an undeveloped district where some high-grade lead-zinc ores have recently been discovered.

ONTARIO

Cobalt.—At the annual meeting of the Mining Corporation of Canada, on June 29, J. P. Watson, president, stated that the new orebodies discovered on the Buffalo property would make a valuable addition to the ore-reserves, now estimated at 1,350,000 oz., and, added to those of the other properties, brought the total up to 2,181,923 oz. as of December 31. The policy of the directors was to go ahead at full speed so long as operations were profitable, but they would not sell silver at a sacrifice nor submit to inefficient labor at excessive wages. The Flin Flon copper property in Manitoba, in which the Corporation had acquired a controlling interest, contained 16,000,000 tons of assured ore, and additional possible and probable ore amounting to 9,000,000 tons.

Goudreau.—The Murphy gold claims have been sold to Toronto interests represented by A. R. Porter. Operations have been begun with J. Diampre, former manager of the Croesus mine, in charge. Stripping is being done and a shaft will be sunk immediately.

Kirkland Lake.—The Bidgood is drifting on the 300-ft. level and is in ore. Extensive lateral work will be done to ascertain the extent of mineralization before continuing the shaft to deeper levels.——The annual report of the Kirkland Lake for the year ended May 31 showed an operating profit of $34,990, as compared with $24,499 for the previous year. The production amounted to $277,007, as against $107,071. ——A long diamond-drill hole has been run at the 400-ft. level to find the position of a vein showing at the surface and several hundred feet south of the main vein.

Porcupine.—At the McIntyre the No. 7 vein has been intersected by a cross-cut driven at the 1375-ft. level, which has passed through 20 ft. of $30 ore.——As an indication of the greatly increased efficiency of labor it is stated that the Hollinger Consolidated is now mining and milling about 2¼ tons of ore daily for each man on the payroll, as compared to 1⅓ tons when efficiency was at its lowest.——The Dome Mines is making further experiments with cyanide, and is at present using the low-grade product of the American Cyanamid Co., of Niagara Falls, in place of the high-grade article imported from Scotland.

Obituary

Albert L. Waters died on May 29 at Chun Ping, in China, where he was in charge of a lead-mining enterprise controlled by Chas. E. Richardson & Co., Ltd., of Swatow.

Warren B. Shackelford, one of the most widely known mining operators of the Joplin district, died recently at St. Luke's Hospital in Chicago following an operation. He went to Webb City during the boom of 1898-'99, where he became associated with the late Charles Read in the Bunker Hill mine at Oronogo. Later he became interested in the Snowbird mine at Carthage, and still later was made manager of the Good properties north of Webb City. He was associated with the S. Y. Ramage lead and zinc mines, north of Carterville, serving as general manager for that company. In 1915 he became general manager for three mining firms, Admiralty Zinc Co., Queen Astor Mining Co., and the Sinden Zinc Co., all of which are situated in the Oklahoma field. He was the first man in the district to use water drills to lessen the dust and improve working conditions underground.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

R. W. French is here.

Deane P. Mitchell is in Spain.

J. L. Bruce has returned from Denver to Butte.

J. Power Hutchins is residing in Madrid, Spain.

R. L. Chase is examining mines near Lake City, Colorado.

J. R. Finlay, of New York, is residing at Redlands, California.

G. F. Carr, of Long Beach, California, has moved to Tonopah, Nevada.

L. Vaughan has opened an office at Kroh, in upper Perak, Malay States.

Wilbur H. Grant has returned to San Francisco from Zacatecas, Mexico.

John Graves, Jr., mining engineer of Salt Lake City, is at Kansas City, Missouri.

Douglas Clark has moved from Iquique, Chile, to Stanford University, California.

Edward McDonald has returned to Berkeley, California, from Durango, Mexico.

Douglas Lay has been appointed manager of the Le Roi No. 2, at Rossland, B. C.

J. W. Finch visited the Rand and the Congo on his return from China to New York.

Herbert Laycock has returned to San Juancito, Honduras, from Berkeley, California.

F. G. Cottrell and **Van. H. Manning** are in Europe, engaged in scientific investigations.

C. W. Purington expects to be in Boston shortly, and later will come to San Francisco.

Walter G. Perkins has returned to his former London address at 62 London Wall, E.C.

Charles D. Kaeding has gone to Nevada where he will visit the Simon and Candelaria mines.

Rensselaer Toll is superintending the Blue Mountain gold mine, in Kern county, California.

G. C. Martin, of the U. S. Geological Survey, is studying Yukon and Koyukuk river-basins.

G. W. Schilling has returned to California from Seward, Alaska, and is now at Hollywood.

Courtenay De Kalb has been at Houston, Texas, and is now inspecting mines in central Georgia.

C. E. Chaffin, New York representative of the General Engineering Co., left for Bolivia on July 13.

Vernon S. Rood, general manager for the Utah Apex Mining Co., at Bingham, is on a trip to the Yellowstone Park.

Seeley W. Mudd and his son, **Harvey S. Mudd,** have moved their offices to 1203 Pacific Mutual Life building, Los Angeles.

K. Tawara, Professor in the College of Engineering, Metallurgical Department, of the Imperial University at Tokyo, is at the Fairmont hotel.

J. M. Callow, president and general manager of the General Engineering Co., has returned to Salt Lake City after spending six weeks in New York.

R. C. Gemmell spent several days in San Francisco recently. **R. G. Lucas,** attorney for the Utah Copper Co. at Salt Lake City, accompanied Mr. Gemmell.

P. G. Beckett, general manager for the Phelps Dodge Corporation, at Bisbee, Arizona, is in New York. He visited the Yellowstone Park and Salt Lake City on his way.

O. B. Hofstrand, metallurgical engineer, has returned to Salt Lake City after having completed an extensive investigation of the Tintic Milling Co.'s plant and process at Silver City, Utah.

THE METAL MARKET

METAL PRICES

San Francisco, July 19

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.00—13.50
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$70
Platinum, 10% iridium, per ounce	$88
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

July 18.—Copper is inactive and slightly weak. Lead is easier but prices are unchanged. Zinc is quiet and easier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
July 12	59.50	37.00	June 6	57.68	33.75
" 13	60.62	37.75	" 13	58.39	35.29
" 14	60.75	37.75	" 20	58.77	35.18
" 15	60.50	37.75	" 27	58.69	35.25
" 16	60.50	37.75	July 4	58.90	35.33
" 17 Sunday			" 11	58.69	36.75
" 18	59.62	37.37	" 18	60.25	37.56

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
July 12	12.62	June 6	13.08
" 13	12.62	" 13	12.91
" 14	12.62	" 20	12.85
" 15	12.62	" 27	12.68
" 16	12.62	July 4	12.62
" 17 Sunday		" 11	12.62
" 18	12.62	" 18	12.62

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
July 12	4.40	June 6	4.90
" 13	4.40	" 13	4.75
" 14	4.40	" 20	4.47
" 15	4.40	" 27	4.32
" 16	4.40	July 4	4.43
" 17 Sunday		" 11	4.43
" 18	4.40	" 18	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
July 12	4.80	June 6	5.17
" 13	4.75	" 13	4.98
" 14	4.75	" 20	4.95
" 15	4.75	" 27	4.88
" 16	4.75	July 4	4.75
" 17 Sunday		" 11	4.77
" 18	4.75	" 18	4.76

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.50	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.09	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
June 21	50.00	July 5	48.00
" 28	48.00	" 12	48.00
		" 19	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	80.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

WE MUST WORK OUT OUR OWN SALVATION

Instead of waiting for some mysterious set of forces to restore good times, the people of the United States have settled down to the grim and sober business of working out their own salvation, writes Archer Wall Douglas, chairman of the Committee on Statistics and Standards of the Chamber of Commerce of the United States, in his monthly review of business conditions in the August number of 'The Nation's Business'.

While the return to better times is certain to be slow, he says, there can be no doubt as to the final recovery. "The story of the present business depression", says Mr. Douglas, "is very similar to other depressions which have occurred during the past half century. The beginning of the end of speculation and over-expansion came with restriction of credit that put a sudden crimp in the volume of business and started prices downward on their long journey of declines. Then followed the slowing down in industry, the incubus of much unemployment, and all the attendant evils of hard times. After the first shock, there were a flood of forecasts of an early return to former conditions and the passing of those ills which afflicted the country. Invariably the prophecies came to grief.

"One of the earmarks of past depressions was the fantastic schemes advanced to prevent the return of such eras. These schemes included the stabilization of prices and doing something to the currency so that its purchasing power would always be the same. And there are those among us who take these theories seriously today just as our forbears did in their day. We have at least one consolation in this generation, that out of the welter of past misfortunes we have learned the lesson of sound financial system as embodied in the Federal Reserve Bank."

ADVICE FOR THE INVESTOR

Two of the most effective arguments of the get-rich-quick promoter have been outlined in this column, says a writer in the New York 'Evening Post'. The first is the one which impresses the prospective victim with the necessity for immediate action and makes many small savers bind themselves first and investigate afterward. The second consists of a promise of excessive dividends and the apparent honoring of that promise by payments of capital, part of the money paid in by the second batch of victims furnishing dividends for the first batch, and so on, until the law steps in and cuts the chain. The third argument in the order of effectiveness is one used on prospective buyers who do not fall on the first attack. It sets up shining examples of how money invested in the original stock of a corporation now at the top of the ladder, has multiplied from 10 to 100 times. If it is an oil stock that is being offered, the Standard Oil Co. of New Jersey is set up as an example of what has happened and what is likely to happen again. If it is a company which the promoters intend to have manufacture some specialty, the tremendous increase in the value of stocks like Eastman Kodak, Gillette Safety Razor, or Welsbach Mantle is used as bait. A new finance corporation usually points to some top-notch corporation which has realized wonderful success through years of sound management. To the unwary this in general is a powerful argument. An investor possessing even an ordinary sense of conservatism will be likely to inquire whether there is anything in common between the untried beginner and the seasoned veteran other than a common business.

MONEY AND EXCHANGE

Foreign quotations on July 19 are as follows:

Sterling, dollars:	Cable	3.59½
	Demand	3.60½
Francs, cents:	Cable	7.85
	Demand	7.87
Lire, cents:	Demand	4.58
Marks, cents		1.35

Eastern Metal Market

New York, July 13.

There have been no important changes in the prices of non-ferrous metals during the week.

Buying of copper continues light and prices continue about the same, with fewer sellers willing to quote below 13 cents.

With the exception of one day, when 300 to 400 tons of tin was sold, there has been no activity during the week.

Lead prices are firm despite the small demand.

Improvement in the zinc market awaits betterment in the brass and galvanized-sheet industries.

IRON AND STEEL

Less rather than more buying has followed the formal posting of new steel price-lists last week, and steel-works operations have not improved, says 'The Iron Age'. Buyers do not question that prices are generally below cost, but they need little steel and await the effect of adjustments in labor and freight-rates.

Further wage-reductions by independent steel companies will go into effect July 16. The rate for common labor is reduced from 37 to 30c. per hour, making the total reduction from the peak about 35%. The Steel Corporation, by abolishing the eight-hour basic day, comes to 37c. per hour for common labor. There are predictions of a 25-cent rate before the downward movement is stopped, as against 19c. before the War. In one Eastern mill town as low as 20c. is now being paid.

The independent sheet and tin-plate mills made a settlement at Columbus, Ohio, on July 9, with the union workers which means a 10% lower labor cost. The Western bar-iron scale is yet to be fixed. Two independent sheet-makers who signed the scale last year are expected to operate on the open-shop plan in the future.

While offers of Belgian and German steel in the United States at low prices are still reported, sales do not result, all buying being at so low an ebb. In Canada likewise offers of Continental steel have been ignored, though at $10 per ton below American prices.

COPPER

Producers of copper continue to maintain a fairly firm position notwithstanding the light demand. It is probable that the number of sellers who are willing to shade 13c. is narrowing. The leading producers are adhering to this price and are turning away inquiries from buyers who are hunting for the bargain prices. Smaller producers, who are taking the little business that is offered, quote 12.62½c. for prompt shipment and 12.75c. for July. Buyers are bidding 12.50c. for early shipment, but apparently without complete success, it being difficult to shade 12.62½c. Export demand has slumped slightly, the British exchange situation having affected purchases from that origin, while German buyers for the moment seem to have their wants supplied. Germany has been a consistent buyer in lots usually of 100 to 200 tons for some months.

TIN

Except for slight activity on Monday, the market has been quiet throughout the week. On that day 300 to 400 tons was sold, mostly for shipment from the Straits Settlements from June to September. Prices on these transactions ranged from 28 to 28.25c. per pound. Some of the tonnage was for consumers and the remainder was bought by dealers. Otherwise, the market has been featureless. The tin-plate industry continues dull and until there is an improvement there the tin market is likely to continue weak and dull. Prices have softened slightly during the week both here and in London. Practically the only transactions are in Straits tin. Banca is little heard of, and apparently is finding its way to the Continent. No. 1 Chinese tin, 99%, for shipment from England is offered at around 27.25c. per pound.

LEAD

Lead has been a little firmer than a week ago, 4.35c., St. Louis, having ruled during the last week as compared with a previous price of 4.30c. At 4.35c., St. Louis, and 4.40c., New York, the leading interest has the market pretty much to itself as none of the independent producers is willing to sell at these figures; they are asking 4.62½c. and will sell only small quantities even at this price. Demand is reported as improving, the storage-battery companies being in the market for a fair tonnage.

ZINC

The slight upward trend in price noted last week was maintained until the beginning of this week, when the market turned soft again, the metal being obtainable at 4.30c., St. Louis, or 4.80c., New York, as compared with 4.35c. and 4.85c., which ruled last week and a part of the week before. Business continues dull, and it is not expected that there will be any sound improvement until the sheet-mills experience a better demand for galvanized sheets. The brass industry, a large user normally, also continues dull.

ANTIMONY

The market is slightly easier today, quotations of 4.65c. having been made on spot carload lots, f.o.b. New York, duty paid. Buying is at low ebb.

ALUMINUM

The leading producer continues its quotation of 28c. for virgin pure metal, 98 to 99%, f.o.b. producer's plant, while the same grade of foreign origin is available at 22.50 to 23c., New York.

ORES

The prospect of a tariff on tungsten ore has stiffened prices somewhat. There was an inquiry a few days ago for 300 tons, on which buyers expected quotations of $3 to $3.25 per unit, but some sellers are holding for as much as $4.50. In the absence of business the market price is not well defined and whether purchases could be made under $4.50 has not been determined.

Ferro-tungsten is quoted at 48 to 50c. per pound of contained tungsten in lump form, guaranteed as to quality, but some grades can be purchased as low as 40 cents.

Molybdenum: A nominal quotation is 50c. per pound of MoS_2 in regular concentrate, usually 85%, but some sellers are holding for 60 to 65c. for this grade.

Manganese Ore: With stocks of ferro-manganese exceeding requirements and ferro-manganese furnaces almost all out of blast, there is no demand for manganese ore, prices of which are slightly weaker. High-grade foreign ore is now obtainable at 22c. per unit. The impression prevails in the trade that the proposed duty of 1c. per unit will not stand in that form when the bill is finally passed.

Manganese-Iron Alloys: The demand for ferro-manganese is confined to an occasional carload lot, quotations from selling agents for domestic producers ranging from $70 to $75 per ton, delivered east of the Mississippi river. British selling agents nominally quote $75, Atlantic seaboard, but would doubtless meet competition if real business were offered to them. Spiegeleisen is likewise weak and featureless. Quotations varying from $26 to $30 are reported, and there is no doubt that the lower figure could be done if any business of importance were offered.

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T. A. RICKARD, - - - - Editor

CONSIDERABLE interest was shown a few months ago in a new flotation process with which the name of Luckenbach was associated. In the department allotted to 'Industrial Progress', which is set aside for interesting information contributed by manufacturers and their agents, we print a statement sent to us by Mr. Roger Luckenbach himself. Whether a pine-pitch solution evades existing patents is a matter of opinion, legal more than metallurgical.

HOLDERS of U. S. Steel Corporation common stock at the closing of the books for the June dividend numbered 105,310. This was the largest on record and showed a gain of 934 since March. The owners of preferred stock in the same enterprise numbered 81,614 at the end of May, so that, exclusive of duplications, the U. S. Steel Corporation has about 165,000 shareholders. This is an interesting example of the way in which a wide public interest is created for the stock of an industrial enterprise, and it suggests a recruiting of capitalists from the ranks of labor.

THE visit of the U. S. battleship 'Tennessee' to San Francisco recently served to draw attention to the success that has attended the extension of the application of the electric motor; for this ship was the first battleship to be designed specifically for steam-electric propulsion, being equipped with Westinghouse machinery for this purpose. The turbo-generators deliver a 3400-volt current, each unit, with exciter, condensers, and other auxiliary apparatus, occupying a water-tight compartment. The four propeller-motors are each of 8375 horse-power, and are also contained in water-tight compartments. The 'Tennessee' is a magnificient craft, 624 feet long, and of 33,000 tons displacement. The extraordinary steadiness of the vessel is indicated by the fact that a pool-table is provided for the use of the crew. The combination of oil-burning boilers and electrically operated machinery is an evidence of progress in marine engineering.

SPEAKING of the papers published by the Institute and the needless expansion of its activities in that direction, we instance several papers, in pamphlet form, received recently. One deals with 'Transition Phenomena in Amalgams'. This refers to dental amalgams and should have appeared in the transaction of a dentist's society. It has no place in a mining and metallurgical publication. 'The Geology of the Namma Coal Field, Burma', is unlikely to interest many of our members; the printing of it is merely a courtesy to the author. 'Underground Mine Development, Its Definition and Valuation' is a note, occupying seven pages, that might be published suitably in the technical press, but is unsuitable for the Transactions. Even Mr. H. V. Winchell's timely and interesting sketch of geologic conditions at El Oro and Pachuca is more suitable for the technical press, where it might elicit useful discussion, than in a reference library such as the bound volumes of Transactions.

RELIABLE statistics have been lacking, since the beginning of the War, of the production, consumption, and commercial movements of many of the non-ferrous metals. This has now been remedied by the issuance of a year-book by the American Bureau of Metal Statistics, of which Mr. W. R. Ingalls is Director. It is explained that during the four years of the War, as well as during the year or so that followed, statistical records were neglected, with the result that serious gaps were noticeable in statements that attempted to show the world's production of copper, lead, and zinc. The Bureau has succeeded in obtaining most of the information that was lacking, thus permitting a relatively complete series of tables to be issued. State departments that issue statistics of national importance are usually prompt, but few governments give the necessary information; our own, we are told, was unable to furnish essential data; figures obtained from this source were sometimes in serious error. The publication of a year-book of such statistics will draw attention to the need for accuracy.

CHARLES G. DAWES, Federal Director of the Budget, has proved himself to be unusually versatile, resourceful, and aggressive, but we suspect that the task before him now is the hardest he has ever undertaken. Three weeks after assuming office he reported a possible gross reduction of some $115,000,000 in the expenses of running the Governmental departments during the present year. However, it is one thing to point out where savings can and ought to be made, as Mr. Dawes seems to have done, and quite a different thing actually to detach from the Government payroll enough employees to account for a saving of $115,000,-

000 or any considerable part of that sum. For every score (or thereabouts) of Civil Service employees there must be a Federal appointee; and for every appointee there must be a Senator or a Representative, who, for one of divers, but none the less potent, reasons, is vitally interested in perpetuating the status of such appointee as a servant of Uncle Sam. Moreover, it is probable that, although the heads of bureaus may be heartily in favor of economy and retrenchment as matters of principle, each might consider the suggestion of a curtailment of his essential activities as preposterous. We are inclined to prefer the balance-sheet at the end of the year, instead of the budget at the beginning of it, as an index to the economical conduct of our Government, particularly in view of the prevailing custom of squaring accounts by means of the Deficiency Appropriation Bill. Nevertheless public sentiment is unusually strong in favor of economy, and Mr. Dawes is not afraid of offending, or averse from fighting, strong 'influences'; so we may be pleasantly surprised. We hope so.

AT LAST the worm has turned! It is a long worm that has no turning. Our contemporary in New York, declining at first to join us in a frank criticism of the Institute's exuberance as a publisher, has now endorsed our criticism, and in a most effective manner. We demur, however, to two items: the comparison of the Institute magazine with 'The Mining Magazine', for in one regard if not in several, the publication in London deserves respect, namely, for its précis of technology, which is a credit to technical journalism. We demur to "there is some data"; if the editor in New York had profited by the lessons given in 'Technical Writing' instead of permitting the publication of a mean review of that little book, such a blunder would not have appeared on the editorial page of our contemporary. However, that is by the way. We are amused to learn that the 'Engineering and Mining Journal' offered to act as an organ of publicity for the Institute, that is, to combine with the Institute in publishing much of the piffle that appears now in the Institute magazine. One practical suggestion, however, is offered: it is that the Institute charge $1.50 per annum for its magazine to those who wish to receive it. That is a good idea; for then the Institute would not be debited with the cost of those copies of the magazine—about two-thirds, we venture to surmise—that go into the waste-basket, and its unfair competition with the technical press would be abated, although not entirely stopped.

THE prospectus of the Santa Monica-Bakersfield Oil Company has been sent to us, by a reader, because it contains sundry oddities. For instance, it asserts that 62% of oil enterprises succeed, whereas only 50% of the drug stores and 33% of the groceries are successful. What is the criterion of success in the oil business? Is it the winning of oil at a profit large enough to amortize the capital investment, plus, say, 15%, on the principal, or is it the persuading of the public to subscribe for stock the face value of which is never redeemed? In the case of the company mentioned, the seeking of oil is supplementary to the working of sundry claims containing veins of gold and silver, principally silver, concerning which two interesting statements are made: the first is that "silver is now stabilized in value at $1 per ounce", and the second that "silver ore increases in value by depth". As to the first statement, we agree that the price for silver of domestic production is safe at $1 for about three years, but that does not warrant the unqualified assertion just quoted. As to the second, that is a nursery tale. *Credat Judaeus Apella.* In Orange county, where the company's oil-land is situated, "there exists a vast sea of oil!" The mark of exclamation is not ours; it appears in the prospectus. Another "geological indication" is based upon the supposed fact that "the Miocene, Pliocene, and Eocene strata are the acknowledged oil-bearers"; therefore, of course, if you have on your land any strata belonging to these three sub-divisions of geologic time you are sure of finding oil in them. The prospectus appeals to "the thrifty man or woman" and asks him or her to become "a business colleague" with the gentlemen who have this affair in hand. We believe they are honest, but ignorant.

A RECENT yarn in 'The San Francisco Examiner' is headed thus: "Sinaloa Placer Gold Deposits so Rich as to Tax Human Credulity". The article says that Mr. Ralph L. Van der Naillen of Oakland has returned from Mexico with a collection of gold nuggets, ranging from half an ounce to four pounds in weight, these being typical of what can be found readily along the Yaqui, Mayo, Fuerta, and Sinaloa rivers in northern Mexico, on thousands of square miles of placer ground for which he, Mr. Van der Naillen, has secured concessions from the Mexican government and on which he "contented himself with saying, gold in paying quantities existed everywhere". "Everywhere" is comprehensive. So is this: "Coarser gold, too, he found in abundance on the Fuerta river, where one of the vastest deposits of pay gravel exists that heretofore has been found anywhere on earth". He asserts that he found "wonderful deposits of ancient gravels such as early explorers saw in Nevada and Butte counties, California, but extending over a far greater area, and as far as sinking shafts to bedrock, drilling, panning, and other exploratory work disclosed, these gravels are even richer than the product of those placers which served to build up San Francisco from a slumbering Mexican outpost to the metropolis of the Pacific". How much of this ebullition may be attributed to the imagination of the reporter who interviewed Mr. Van der Naillen and how much to that gentleman himself we do not know. If the interview had taken place in Mexico one might suspect the vivifying effect of the well known distillate from the plant known as the agave, but this possibility should be precluded by the fact that the meeting took place within the scope of the 18th Amendment. Two features of Mr. Van der Naillen's adventures arouse particular curiosity. We learn that

"even the adobe walls of the hovels in which the Indian population dwell, when pulverized with a hammer and washed, disclose a long pay-streak in the pan". Why were the huts demolished when clay similar to that from which the bricks were made must have been abundant? But the most interesting part of the account from a technical standpoint has to do with the examination of the craws of a number of chickens provided for dinner. It seems that Mr. Van der Naillen's cook was not to be outdone by the others in the party in his earnestness to find gold. He was rewarded on one occasion by finding, in the gizzards of a number of fowls, quartz sand and coarse flakes of gold "readily visible to the naked eye", and in quantity sufficient to fill a "small homeopathic vial about one-quarter full". Now if the sand in the yard where the chickens ran had been so rich it doubtless would have attracted the keen attention of the gold-seekers; so that it is reasonable to assume that the fowls had in some manner effected an excellent concentration. The question arises whether these particular birds were endowed with a genius for selecting only goldbearing quartz in the course of their daily scratching, or whether their gizzards had some strange preferential affinity for the valuable particles which they retained while the valueless quartz was being discarded as 'tailing'. Fortunately Mr. Van der Naillen declined to furnish any figures on the probable value of the gold in the ground comprising his concession, for, as the interviewer remarks, "such a calculation would stagger human reason". How very thoughtful! and so like the 'Examiner' and its scribblers.

PREVENTION is better than cure; by isolating the unfit, the frequency of industrial disease and poisoning would be reduced, and some occupations now regarded as dangerous might be rendered safe. We drew attention to this recently in discussing miner's phthisis, and the need for the enforcement of a regulation that tuberculous men should not be permitted to work underground. This is also the opinion of Sir Kenneth Goadby, as expressed in a paper read recently before the Royal Society of Arts. Modern research, we are told, has shown that the white corpuscles of the blood are the chief destroyers of living germs and poisons, and that diminished resistance to poisons is accompanied by a decrease in their number. In his researches on the composition of the blood, Sir Kenneth found that, in all chronic infections, an alteration in the proportion of white cells to red cells may be detected, this change occurring before the outward signs of ill health are apparent; diminution in the number of white-blood cells is accompanied by diminished resistance to such poisons as lead and mercury, making persons in such a condition particularly susceptible. He recommends therefore that tests (blood pressure and blood counts) be made on persons entering such occupations; and he urges that trade-unions encourage the formation of special health committees, not for providing medicine for the sick, but for conserving their capital, health.

Volatilization of Metals

In this issue we publish an article, by Mr. Thomas Varley, the superintendent of the Intermountain experiment station of the Bureau of Mines, and Mr. C. C. Stevenson, a metallurgical research Fellow at the University of Utah, on the volatilization of metals in ore. This paper gives an account of the work that has been done to date, covering the volatilization phase of a process that may become of commercial importance. There seems to have been no difficulty in separating the metal or metals from the gangue; the trouble has been to obtain a product without incurring prohibitive losses between volatilization and realization.

The earliest investigator in this most interesting field of metallurgical research was Mr. Stuart Croasdale, who published, in 1903, the results of tests at Denver on complex silver and gold ores, particularly in connection with those that contained copper. This particular problem, by the way, is one that is engaging the attention of a number of mining companies. There is, for instance, an immense deposit of comparatively low-grade silver ore in the Cerro de Pasco mine, in Peru; copper is also present in an undesirable quantity; there is too little in the ore to justify smelting and too much to predict a favorable result from ordinary cyanidation. Research and experimentation are being carried out on the property, the work being in the capable hands of Mr. Rudolf Gahl, whose conclusions will be of considerable economic significance to the Cerro de Pasco company. Mr. Croasdale's original tests were made by placing the mixture of crushed ore and salt in a clay roasting-dish, and by heating it in a muffle. It was found that nearly 98% of the precious metal could be volatilized in an hour. The best results were obtained when the amount of salt added was equivalent to 4% of the sulphur in the ore, which was ground, according to requirements, to pass a screen that varied from 20 to 60 mesh. The temperature was maintained at about 1000° C. For practical operation a cylindrical revolving furnace was recommended. It was found that volatilization was efficient only with excess of air, and only when the roasting was accompanied by constant rabbling. For the collection of the fume, Mr. Croasdale tried cotton and woolen bags, scrubbing-towers, and burlap filters, aided by pressure or suction. Great difficulty was experienced in the collection of the copper chloride, the failure in this respect leading to a lack of confidence in the possibilities of the process. In 1913, however, Mr. Ben Howe reported the successful volatilization of gold from a complex ore in Western Australia; during the same year the writer of these notes duplicated the results on a small scale, but on an ore of almost identical character in Africa. Mr. Howe's plant, which showed an appreciation of most of the principal recommendations in Mr. Croasdale's earlier work, was complete, and gave excellent results, although the scope of the operations was restricted by shortage of funds. A rotary brick-lined furnace was used, the ore being heated by means of an oil-burner. The charge, containing 5% of salt, was fed

into the volatilizer by means of a screw-conveyor; the fume passed into a dust-chamber, and then through traps of different types, water being used to assist in the removal of the metal from the gas. In these tests there was no question about the successful volatilization of the gold; but, so far as actual saving was concerned, the process was viewed with a considerable amount of scepticism. Subsequent developments have proved that this was justified.

Increased attention was directed to the process in 1913 by the successful experimental work of Dr. F. G. Cottrell in connection with the electrical precipitation of dust and fume. In the utilization of Dr. Cottrell's discovery would seem to lie the hope of the commercial success of the volatilization process. Mr. Croasdale's work, however, not only opened a promising avenue for industrial research, but indicated a greater need for care in the use of salt during the various stages of gold-ore treatment. The ease with which gold could be 'lost' was not generally recognized; it was always looked upon as a particularly stable element. Discrepancies and variations between the results of different assayers and between theoretical estimates and actual yields were attributed to many causes, but volatilization was seldom considered as worthy of consideration. Following an appreciation of the effect of the addition of salt before roasting, it was considered in many quarters a wise precaution to omit the use of a salt cover, or the admixture of salt with the charge, in assaying precious-metal ores.

The ultimate efficiency in the treatment of gold ores is usually judged by the amount of metal that is left in the residue. At one large plant at Kalgoorlie, for example, a concentrate was roasted, prior to fine grinding and cyanide treatment; and it was found that the previous admixture of salt led to a poorer residue. The indicated extraction without the use of salt was from 80 to 90%; with the salt it rose to 97%, as shown by loss in residue. Although the amount of salt that was added (four pounds per ton) was small, it is not unlikely that some volatilization took place during roasting, and this tended to swell the 'unaccountable' loss that often accompanied cyanidation in the earlier days of the process.

In reviewing the subject we are struck with the apathy that followed the pioneer work of Mr. Croasdale in this interesting branch of metallurgy. The best proof of the soundness of his early investigations is that most of his suggestions and conclusions, all of which were of fundamental importance, have been favored by adoption at the hands of later sponsors. The rotary type of furnace has been found to give the best results; the benefit of a scheme of treatment that ensures rapid oxidation is also appreciated. The article on another page will serve to draw further attention to the subject. The facilities at the Bureau of Mines experiment station, for the carrying out of work on the realization as well as on the volatilization stage of the process, are such that important data should be forthcoming from the special investigators who have been entrusted with the experimentation. The treatment of refractory ores presents insistent problems; doubtless, in this work of the Bureau, knowledge of immense scientific and economic value will become available for adaptation in other phases of metallurgical work.

Conditions in Germany

First-hand information is always valuable. For this reason the following impressions of conditions in Germany today will, we feel, be read with interest; they are those of Mr. H. E. Skougor, whose professional connection with Chuquicamata will be recalled, and who returned recently from a trip to Europe in company with Mr. E. P. Mathewson. We learn that there is little difference between the Germany of today and the Germany of 1913. Its cities are clean and orderly. The Germans are working hard and conscientiously, which, as Mr. Skougor remarks, is not the case in many other countries. The restraints and the economies of wartime are still in evidence. White bread is almost unobtainable, even in the best hotels; sugar and butter are classed as luxuries, and little of either is seen; the Germans are buying no cotton, with the result that paper table-napkins and paper tablecloths are being used exclusively; only one out of about ten lamps on the streets are lit at night. Such, he says, are a few of Germany's efforts to economize; the period of readjustment will be all the shorter, far shorter than is generally supposed. Furthermore, a stable Russia is considered as one of the essentials to success in Germany, and better results may be achieved through pressure on the part of Germany than through the diplomacy of the Allies. Germany has procrastinated about the payment of her debts, but that, in Mr. Skougor's opinion, is a national characteristic. The delay has been due in part to the fact that Germany may not have selected the best talent for the presentation of her case, also because of the aloofness of the United States and the lack of unity among the Allies. It is maintained that a definite stand must be taken and adhered to. Germany is unable to withstand aggressive action; the Germans want to know how long Poland will be allowed to disturb their frontiers, and also if they are to be permitted to retain their holdings in Silesia and in the Ruhr district. It is suggested that when Germany knows the conditions she has to face in the immediate future she will be able to organize her industries on such a basis that the debts will be paid. Can the United States, having attained financial sovereignty, afford to maintain her old-time policy of isolation? Germany, remarks Mr. Skougor, is today pinning her hopes on the Premier of Great Britain, Mr. Lloyd George, who is viewed in Germany as being far-sighted and broad-minded to a degree that sets him above contemporary statesmen. Our informant deplores the fact that there are so many empty vessels in the harbors of the world, that factories are inactive or working half-time, and that men are idle. Unity of action is needed, together with the application of the laws of economics, influenced with as little as possible of passion and temperamental bias.

Standardizing Steel for Mining and Milling

The Editor:

Sir—Science is classified knowledge. In order to classify the existing knowledge of any subject, a detailed and exact study must be made. The laws that govern cause and effect must be interpreted, and the varying effects of the many factors entering into combinations must be co-ordinated and classified.

The wide variation in mining and milling processes, dependent on the character of rocks and ores handled, makes it difficult to standardize materials that are made of steel, so that they will be adaptable to all equipment and to all conditions. In reviewing the attempts and efforts to establish standards I note a lack of co-operation between the mining men producing the ores, between the millmen treating the ores, and the steel-men supplying the materials for the equipment used. The mining engineer has the problem of digging the ore; the mill-metallurgist and engineer, the problem of crushing the ore and of recovering the valuable minerals and metals; and the steel metallurgist, the problem of supplying material that will most efficiently and adequately accomplish the results sought for by the other two.

Frequent references have been made in the mining journals to the performance of steels used in mining and milling operations. Numerous experiences have been cited of failures under certain conditions, and successes under other conditions. Those conditions have included the kind of rock handled, the type of machine used, the skill of the operator, and often the kind of steel used, and the treatment of it, either by the manufacturer or the user. Experiences have covered all types of machinery, such as stamp-mills, crushers, rolls, balls, liners, dredges, and smelting equipment. Writers have considered failure of material, such as abnormal breakage, premature wear, and non-adaptability. Often a part made of identical material failed with one operator, whereas, with another, success was achieved.

It must be realized, primarily, that the manufacture of materials into a product, and the process using that product, are two opposite phases of the situation. The manufacturer of steel to be used for a machine, or part of a machine, is concerned with the treatment and the performance of his product, in the use for which he sells it. A manufacturer of drill-steel is interested in the treatment and the performance of that steel for rock-drills; a manufacturer of lips for dredge-buckets is concerned with the treatment and utilization of his steel in that product. But the user of drills and drilling machines is essentially concerned with the drilling of rock, for which he buys drill-steel and drills. And, likewise, the user of bucket-lips is essentially concerned with the digging of earth, rock, and gravel, for which he buys lips. Also the manufacturer of the drill-steel is not informed in detail of the operation and performance of drilling machines and the drilling of rock. And again, the manufacturer of bucket-lips is not generally fully informed as to the details of digging machinery, of the factors and vicissitudes attending such operations. Often, however, special men are put in the field to obtain such information for the manufacturer; it may be stated that the mining engineer is not a steel metallurgist, nor is the steel metallurgist a mining engineer.

The question then arises: how may the deficiency be remedied, so that each may combine the special and classified knowledge of his particular science, for the benefit of the other? Will the mining engineer and mill metallurgist devote his time and study to the problems of steel manufacture, or will the steel metallurgist devote his time to a study of the conditions that exist in the mining and milling processes?

No dogmatic opinion is expressed, but I offer a proposal for the solution of the problem. The steel metallurgist can better go to the mines and mills and study the conditions affecting the use of steel materials, than can the mining engineer and mill-metallurgist go to the steel mills and learn steel making and the treatment of steel. This opinion seems valid for many reasons. The steel metallurgist is essentially a material-supply man. His processes have, for their origin, the utilization of materials—steel and iron. His studies and experience have taught him the results of combinations of iron with carbon, with manganese, with silicon, with nickel, with chromium, with vanadium, and with other steel-improving metals. By subsequent treatments he understands how those properties may be intensified and modified. He appreciates the application of the characteristics of various steels, and the selection of the steel most adaptable to certain conditions is his problem. With his knowledge, the steel metallurgist will be enabled to assist, and to take the initiative in benefiting the material-standards problem in mining and milling.

The steel metallurgist is, primarily, the best man to study the problem. But it must not be inferred that the operator's experience with materials is not of great value. "The proof of the pudding is in the eating", and no benefit would accrue unless the opinion of the operator was taken into consideration. But as the material problem is essentially the manufacturers' burden,

why put it on the mine and mill operator? In many instances the staff on the property studies the problems of steel and its treatment, and gains a superficial knowledge of the subject that is often more harmful than beneficial.

With all respect to the brains and capabilities of the mining engineer, the mill-metallurgist, and the metallurgist of the non-ferrous metals, and in defence of the steel metallurgist, the following remarks are made. In many milling, and smelting operations, steels of the alloy grades are used in large quantity and in many shapes and sizes. Since alloy steels have been used so extensively for mining and milling machinery, the salesmen of the steel companies have been giving a sort of correspondence education-course on steels, their properties, treatment, and use. This is a good move in the right direction, for it familiarizes the buyer with the product of the seller; it also benefits the buyer because of clear co-operation between the steel-maker and the steel-user. But this educational work has often produced different results. Many operators so educated, superficially, succumb to a malady that arises from the fact that "a little knowledge is a dangerous thing"; they soon pass out of the learning class, and themselves become experts (?). Then opinions are expressed, often to the detriment of the manufacturer's product. For frequently one operator's unfavorable report on a steel product is not justifiable, for the user of the product is often more to blame than the manufacturer. On the other hand, it must be admitted that an operator's observations and opinions have saved the steel-maker from much grief.

The steel metallurgist is a specialist, and his knowledge cannot be acquired to the same extent by one who is a specialist in another field. Therefore, why not call in the steel metallurgist, put the problem of material performance up to him, take him to the mines, the mills, and the smelters, and co-operate with him on the ground? This procedure should appear reasonable and logical; it should give results, for it places the work in the proper hands, and utilizes the brains of those who understand the material being considered. Selection of the proper steel for use requires careful study, equal to the manufacture and treatment of it; for the one can only be the complement of the other.

An abstract ('M. & S. P.', March 12, 1921, page 361, *et seq.*) from I. M. M. Bulletin 196, stated that the Mines Selection Committee had reported the tests on 38 drill-steels, and had reached certain conclusions. Conclusion number one said: "There is no practical difference in open-hearth, Swedish-bessemer, electric or crucible-steel, provided they are of the same composition". These conclusions, of course, were obtained on drills, made from the respective steels. I would like to inquire as to the manner in which these steels were treated as drills, to give results that showed "no practical difference" in their performance as drills. Were all the conditions of the tests identical for the four grades of steels tested? A drill to be of any efficient use must be heat-treated to develop properties required in such use. It would be reasonable to infer that the steel was mishandled, or that the correlation of the results was inaccurate.

A Swedish- or British-bessemer steel, having the same composition as a basic open-hearth steel, will not give the same results in a test specimen. A difference would be a definite advantage or disadvantage. What appears to me as an inconsistency is the fact that no one of the four steels showed any "practical" advantage or difference over another; the Swedish-bessemer and the open-hearth steels showed the same value in drills.

In commenting on the Mines Selection Committee's report, E. A. Wraight states: "With regard to these various deductions I am in agreement with the first statement. Provided that steels are of exactly identical composition, there is no valid reason why steel made in the acid open-hearth furnace should not be equally efficient as steel produced in the crucible".

In criticism of this statement, I beg to submit a few valid reasons why Mr. Wraight's statement is incorrect.

1. Crucible steel is homogeneous. Its manufacture in small quantity assures this quality.

2. Acid open-hearth and all open-hearth steel is impregnated with occluded gases and oxidized products, which decrease the ductility and the tenacity of the steel.

3. The fatigue-efficiency of crucible-steel is greater than that of acid open-hearth steel, and also the efficiency of the steel for hardening purposes.

4. Homogeneity promotes efficiency, by the uniformity of the crucible product.

5. Tool-steel quality cannot be produced in the acid open-hearth furnace. The commercial size of the open hearth precludes this.

6. The care and selection in crucible melting-stock guarantees a purer and more homogenous product.

These are valid reasons for the higher efficiency of crucible-steels over open-hearth steels, acid and basic. Efficiency, undoubtedly, refers to performance in service; but such performance depends on the treatment in the first stages of manufacture. In actual use and practice, the compared properties of the two steels exhibit superior performance for the crucible product over the open-hearth product.

Mr. Wraight then continues: "From the financial point of view, steels made in the open-hearth furnace are rarely if ever as pure as the electric or crucible product, and the latter class of material therefore naturally commands a considerably higher price". Why? Simply because of the purity and consequent uniformity of the crucible product, and the absence of interfering foreign substances, which affect the properties of the steel. Mr. Wraight has answered his own question. The less the amount of counter-effectives in steel, the more pronounced is the effect of those elements that are intentionally put there.

In standardizing a material for a certain use, some system must be adopted. No material can give satisfying service and performance unless it be intelligently handled, with a knowledge of its properties and the require-

ments of its uses and applications. For many of the articles written on the subject it would be simple to infer that the purchase of the materials has been conducted with only a superficial and indirect knowledge of the requirements. The treatment of the material, and its adaptability for the use for which it was purchased, have not been in harmony. In many cases, no doubt, the proper material was purchased, but its subsequent treatment was not properly conducted. In this respect the heat-treatment of steels is referred to. In many plants this subject is not given the consideration it deserves, and less knowledge of the subject is exhibited than in any other phase of the materials problem. Standardization must be adopted for the equipment that is needed to treat and handle the material in a proper manner.

The human side of the problem must not be ignored. Why not standardize the men to do the work, also? Why put the millman, the mining engineer, and any of the staff of the mine or the mill on the steel-materials problem? To adapt material and equipment to a job, and do it efficiently and economically, by correlating the many tangible factors of the problem, means to standardize. Then why not properly adapt the problem to the man best qualified to handle it? Every small plant would not require a steel metallurgist, nor could many afford it. Neither does every mine employ a mining engineer; nor every mill, a metallurgical engineer. The work can easily be divided among many mines and mills in a district or territory.

Comment is invited on the solution of the problem, as to how the mine and mill operator can best get the proper materials to carry on his operations. It is not possible nor probable that one specification will cover all uses of the same material. Nor will any one treatment serve to condition the material for all kinds of service and performance. The problem is specific, not general. It must be studied from the standpoint of the existing conditions in any specific instance; where duplication of those conditions exists elsewhere, the problem becomes simplified. Cut-and-try methods are discouraging and wasteful. The problem has certain governing laws, causes, and effects; the classified knowledge of the steel metallurgist's science, combined with the operator's experience, will solve it. The co-operation must be close; the steel metallurgist must study the problem at mine and mill.

R. C. Gosrow.

Marysville, California, June 27.

The Copper-Selling Drive

The Editor:

Sir—The predicament in which the copper industry found itself at the close of the War, with over-production, compared with normal requirements and an immense surplus on hand, has been the subject of no little discussion, several conferences, and, last but not least, the consummation of a financing corporation of $40,000,000 to aid Europe in buying cheap copper from the American producer.

Apparently, there is little purchasing activity in the domestic market, although copper is at an abnormally low price, in fact, too low for profitable mining. Several questions arise as we view this state of affairs; for example, why does not the home manufacturer take advantage of the present low price and lay in a stock? Why, with the large number of idle operatives, does the manufacturer not take advantage of the situation and operate on the fabrication of standard articles of copper? (Perhaps these are foolish questions?) Does he lack the capital wherewith to purchase such stock, to operate as suggested? If so, would it not pay him to borrow and take advantage of the present low price? Why does he not borrow? Is it because of the current discount-rates, of banking interest-rates? Are these so nicely adjusted that such an undertaking would be unprofitable? Whatever is the matter, the American manufacturer also seems to need assistance to enable him to purchase some of this cheap copper, and, incidentally, help to 'reduce the surplus'.

What would a graph look like covering the rise and fall of copper prices, and the tonnage shipments made to Europe, in parallel and over the 25-year period prior to the War? It would furnish an interesting study. Offhand, and on recollection, I venture the statement that such a graph would disclose a contemporaneous decline in copper prices with a rise in foreign shipments. In other words, the American copper producer sells all his cheap copper to Europe, and the high-priced metal to the home consumer.

America, charitably recognizing the situation in Europe and the inability of the manufacturers there to buy, also admitting that it is to America's interest to see Europe on her feet, accomodatingly sells our cheap copper to Europe, and helps her to buy it, notwithstanding the fact that the European manufacturer seems to be doing very well, thank you, or better than the home manufacturer. The difference between the several past occasions and the present is that now Europe is unable to buy our cheap copper, so we are to help them out. This cheap copper they will manufacture with their cheap labor, and, when the American manufacturer gets so that he can buy some of the high-priced copper (when we have unloaded the surplus on Europe) and begins to manufacture it under American wages, Europe will be ready to unload an abundance of this same cheap copper, in manufactured form, on the American market. Where, then, will the American manufacturer be? Protected by a high tariff, or, shall we, also charitably, absorb this surplus? Where will the American consumer get off?

For the sake of argument, let us assume that the American manufacturer had a $40,000,000 corporation formed to help him buy up this surplus, that he bought up some of this cheap copper, that he put some of the idle operatives to work, that these operatives, able to buy, indirectly stimulate other industries, that the manufacturer could then dispose of this manufactured cheap copper to American consumers creating a demand for what was formerly a luxury, would he not 'reduce the surplus',

employ now idle labor, favor the American consumer, and, incidentally, be able to compete with the cheaply manufactured foreign article made from cheap American copper?

Charity begins at home. Financing the sale of below-cost copper to Europe and with the other hand throttling the home manufacturer is a short-sighted policy. America has been repeatedly the dupe of the European manufacturers in their copper transactions. In this case, it looks as though the American copper producer is the 'easy mark' of European interests. There is not only the handing over of all our cheap copper, with our own factories idle, but the back-fire of cheaply manufactured articles, made from cheap copper to flood this market just when the home manufacturer is beginning to get on his feet after the long period of depression. That was bad enough in the past, but the present paradox, financing Europe to help her to a gift of cheap copper, is the limit.

L. S. Ropes.

Helena, Montana, July 7.

Coloring of Glass

The Editor:

Sir—Referring to the inquiry by Francis Drake in your issue of June 11, for the cause of the violet coloration of some glass: I fear, from your light comment, that the success of your recent article on 'hootchite', which went the rounds of the newspapers, causes you to attribute too much importance to the effect of inclusions of 'hootchite'. While this mineral is new, the reactions of its principal constituent have been carefully studied for many years, and it can be said with assurance that it does not combine with glass, and that the range of its adsorption isotherm is so small that not even the odor can be permanently held.

Common bottle-glass is made from sand containing iron. If this is permitted to exist in the 'ous' condition it imparts a marked green color to the glass, whereas in the 'ic' (not 'hic') condition it colors the glass a faint yellow, less vivid and considered less objectionable. It is the practice therefore in the manufacture of such glass to introduce a little manganese as an oxidizing agent, but upon continued exposure to light the excess manganese oxidizes, producing a marked violet or purple color.

The most interesting thing about this phenomenon is that it shows that chemical reactions continue in what appears to be an inert mass. I had a set of Warner lenses on my car which were slightly yellowish green when new. Within four years these became a decided violet. Thorpe's 'Dictionary of Applied Chemistry', under 'Glass', explains the action fully, but as the action takes place in the dry it offers no hope as an indicator.

It is hoped that this will discourage neither editor nor correspondents in their search for a reaction which will indicate the presence of 'hootchite' or its emanations. On account of the severe attack upon its outcrops it is generally necessary to employ indirect methods in prospecting for it, except of course in the large cities, where its exploitation is in the hands of the police. With the modern prospector, familiar with the methods of detecting radio-activity by means of a photographic plate, we may still hope.

W. O. Borcherdt.

Austinville, Virginia, June 23.

Revision of the Mining Law

The Editor:

Sir—I notice copy of the 'Proposed Revision of the Mining Law' in your issue of the 18th instant. I have not the time to read the "proposal", which I will do later, but as one who has had much to do with prospecting and prospectors during the past 20 years, incidentally spending a good many thousands of dollars in the business, I want to record my emphatic objection to Section 5. It evidently has been drawn by some professor whose mining experience has been gained in the class-room, and not in the field. It may be drawn to assist needy surveyors.

As every one should know, the prospector does not do his work on Market street, where the sections, and survey-corners are easily ascertained, but in remote and usually almost inaccessible regions, where not one man in twenty knows where one established Government corner may be found, to say nothing of those that might be needed for the particular discovery made by the prospector. I have been interested, directly and indirectly, in hundreds of mining locations during the past 20 years, and can say that in not to exceed 5% of them did we know the description by section, and often scarcely by township, and I think with the aid of my Brunton I can 'run down' a corner with average success. Many of the corners have been destroyed by fire and otherwise, where they were set in the first place, and it often takes a very competent surveyor to identify them. It was in recognition of this fact that the wise men, Senator Stewart and others, framed the law as we now have it—to my mind a very good law, and one that the professors should not be permitted to destroy just to save them from the necessity of exposing their partisanship in apex suits.

Lodes do not conform themselves to section corners. The prospector does not want 'forties' or 160-acre tracts, but "300 ft. on each side of said lode line", running on the strike of the lode; and he is looking for pay-ore in place, not for 160-acre tracts that may be valuable for timber purposes; and he does not want to hold large tracts of land for five years without a discovery, as this proposed law would permit.

A. L. Beardsley.

Taylorsville, California, July 16.

Metallurgical Methods at Rio Tinto

The Editor:

Sir—I beg to call your attention to a slight typographical error in your issue of July 9. In reference to the heap at Bisbee, it should read "containing 1.3% copper", not 13%. As it is an obvious error, it may not be necessary to publish any correction, still I thought I might call your attention to it.

Joseph Irving.

Jerome, Arizona, July 18.

UPPER CAMP OF THE ENGELS COPPER CO.

Operations of the Engels Copper Mining Company—I

By Arthur B. Parsons

HISTORY. The saying that good mines are not found in places desirable for human habitation, like all other proverbs, is emphasized by exceptions. Among these are the Engels mine and the Superior mine, two miles below it, that together comprise the property of the Engels Copper Mining Co. in the northern part of Plumas county, California. These mines are about 25 miles north of Paxton, a station on the main line of the Western Pacific; they are reached by a branch line known as the Indian Valley railroad. Paxton is named after Elmer E. Paxton, who was responsible for the exploitation of the property on a large scale and is now general manager for the company, whereas the mine itself gets its name from Henry Engels, the father of the brothers now connected with the enterprise, who was the first to discover copper ore in the locality. This was about 40 years ago, before the Western Pacific was built; at that time the nearest railroad point was Reno, 150 miles distant, on the Southern Pacific. The present terminal of the Indian Valley railroad near the Superior mine and the company's 1200-ton mill and flotation plant is called Engels, whereas the post-office a few hundred yards farther up the canyon has been officially designated Engelmine by Uncle Sam. Two names for a town of 500 people seems as superfluous as it is confusing; one of them ought to be dropped. In the interests of efficiency and economy it would seem that the Post-Office Department might gracefully yield, thereby saving a syllable and much ink.

I have digressed somewhat from my declaration that Engels is an agreeable place in which to live. It is situated at an elevation of about 4200 ft. on an eastern spur of the Sierra Nevada; the air is dry and exhilarating, and, although snow is frequently deep during the winter, the cold is never excessive. The drinking-water is the finest that can be imagined; it comes from a torrential stream, called Lights creek, that runs through the settlement. The mountains are rugged and the sides are covered with pine, fir, and cedar, this district being part of the Plumas National Forest. Incidentally, the company owns its own saw-mill and cuts its own lumber and mine-timbers. Indian valley is broad and unusually fertile, so that the best of farm and dairy products and meat are obtainable in Engels at moderate cost. The fishing is fine, quail abound, and deer hunters during the season seldom leave disappointed. Assuming that this establishes the first part of my statement as to the attractions of Engels, I trust the remainder of the article to satisfy the reader that the mines are good ones.

The history of the enterprise is unusual in that the man whose hard work and perseverance did most to reveal the presence of the orebodies in the early days is one of the important stockholders in the established company. I refer to William Engels, better known as 'Bill', who is said to have spent 25 years on Lights creek in exploring and prospecting the copper outcrops and in proving the ore. The senior Henry Engels owned and operated a copper and brass foundry in San Francisco during the late 'seventies; his raw material came from the Lake Superior region, and cost him 35 to 40 cents per pound. The story is that he first went into the Plumas County 'copper belt' because of his interest in the metal from a manufacturer's standpoint. Later he financed the work of his sons, Bill Engels making the first discovery of real importance at a point about two

miles up a small branch of Lights creek where the Engels mine and Upper Camp are now situated. Development of this vein continued for some years before sufficient work had been done to prove that the property had real merit. The next step was to finance the undertaking. For this purpose the brothers organized the Engels Copper Mining Co. in 1901 and raised capital for the erection of a 100-ton blast-furnace plant in which it was proposed to smelt medium-grade carbonate ores.

The smelter, situated about a mile below the mine, was finished; an aerial bucket-tramway was erected to deliver the ore to it; and everything was in readiness to commence operations. At this juncture the Government forestry officials stepped in and notified the company that the operation of the plant would not be permitted. Just what their reasons were I have not been able to ascertain, but at any rate the smelter was on the forest reserve and the authority was competent to prevent any smelting operations.

In the meantime the Western Pacific railroad had been completed, thereby bringing rail transportation within 26 miles of the district. Developments in the mine had been encouraging, so the company determined to build a concentrator, helping to finance its construction by shipping high-grade ore to the smelters in Utah. This ore was hauled by team and motor-truck to Keddie, the nearest railroad station, with which Engels is connected by a fairly good highway.

It was at this juncture that Mr. Paxton, who had been financially interested in the company for some time, personally undertook the direction of the enterprise. He and his associates, one of whom was F. Klamp, now vice-president of the company, raised sufficient capital to build a mill with an initial capacity of 200 tons per day (this was subsequently increased to 600 tons); to install a hydro-electric power-plant; and to provide other necessary improvements. Since that time Mr. Paxton has been constantly at the head of the administration and to him is due great credit for the financial success of the enterprise.

Just then flotation was attracting serious attention for the first time in this country, and tests made by the Minerals Separation people indicated that good results could be obtained on ore from the Engels mine. Accordingly, it was decided to adopt the process and to install Minerals Separation machines. The plant, one of the first to utilize flotation and the very first to depend on flotation exclusively for concentration, was completed during 1914. It was operated successfully until shortly after the starting of the new plant early in 1918. The company has always been a licensee of Minerals Separation; its royalty rate of 12c. per ton of ore treated is about the average charged to users treating approximately 1000 tons per day. It is neither excessively high nor is it as low as that of the companies that concentrate large tonnages.

Hauling the concentrate to Keddie by truck was expensive; moreover the future growth of the mine seemed to be assured; accordingly surveys were made for a branch railroad to connect with the Western Pacific. The best route intersected the main line at a point four miles west of Keddie, where a new station was established. This was called Paxton. The construction, financed by the Engels company, which now owns practically all of the stock of the Indian Valley railroad, was rushed during the winter of 1916-1917; the line was completed to Engels in June 1917, although for many months concentrate had been relayed by truck to the completed portion of the road as progress was made. The proceeds from the sale of this concentrate supplied much of the capital needed for construction.

The next step was the construction of a larger and more efficient concentrator. A site was chosen on the steep hillside just south of the portals of the adits through which the Superior mine was worked and two miles below the Engels mine. The firm of Bradley, Bruff & Labarthe, of San Francisco, was engaged to design the plant, the construction of which required the greater part of 1917, being completed early in the following year. During 1915 Edmund Jussen was in charge of operations with John Reinmiller as his assistant. When Mr. Jussen retired, Mr. Reinmiller became superintendent, a position which he retained until the summer of 1919. During the War the enterprise prospered. In addition to paying the following dividends,

1916	$133,451
1917	295,253
1918	269,978

the company spent $1,052,622 of profit in improvements to its mining and milling plants, the operating profit from June 1914 to December 31, 1918, being $1,751,306. This record is still more creditable when it is pointed out that no deferred development account was set up, the cost of all such work being charged directly to operation. However, following the collapse of the copper market in 1919 it became apparent to Mr. Paxton that more efficient and economical operation would be necessary if the enterprise were to weather the dull times ahead.

In June 1919 Robert A. Kinzie, of San Francisco, was retained in the capacity of operating engineer. The plan was that the operating organization should be directly responsible to Mr. Kinzie and that he should be more intimately identified with the affairs of the company than a consulting engineer, while at the same time he would be free to undertake work for other clients. Mr. Kinzie selected W. R. Lindsay as superintendent, and Mr. Lindsay resides on the property. This arrangement has proved highly satisfactory, as the results of operations will indicate.

The company at the present time owns 157 lode claims with an area of 3245 acres; of the total, 23 claims covering 457 acres are patented. It also owns 900 acres of ranch-land acquired primarily for tailing-sites. The following summary of the capital expenditure as of January 1, 1921, is of interest.

Mine development	$140,216.41
Mine property	972,292.30
General equipment	1,465,066.01
Broken ore in stopes	440,337.07
General supplies	267,252.27

Cash and accounts receivable	118,523.97
Indian Valley R. R. stock	392,500.00
U. S. bonds	40,000.00
Concentrates	38,735.08
Advance expenses	41,822.70
Total	$3,916,745.81

The following paragraph from the annual report of 1920 should be noted in connection with the second item above: "No charge has been made covering depletion of orebodies for the year 1920. The original valuation of $802,255.57 for the mines, set up when operations were begun in 1914, has never been changed and the depletion heretofore charged has practically exhausted this account. In other words, the book-value of our entire mining property, after deducting the present depletion reserve of $589,060.84, amounts to only $213,194.73. In view of the large amount of ore now proved and developed, this account will be re-appraised, and pending such action no further charge to depletion reserve will be made". It is obvious that the 'book value' does not represent actual worth.

The production by years, commencing with 1915, is given as follows:

Year	Ore shipped or milled, tons	Copper in ore or concentrate, lb.
1915	59,714	2,893,133
1916	138,712	4,312,408
1917	157,423	5,940,741
1918	266,636	9,419,957
1919	285,113	8,600,000
1920	239,612	8,571,569

The following statement of ore-reserves, as estimated by Mr. Kinzie on January 1, 1921, is extremely conservative; it does not include any ore indicated by diamond-drilling.

Ore-Reserve in Tons, December 31, 1920

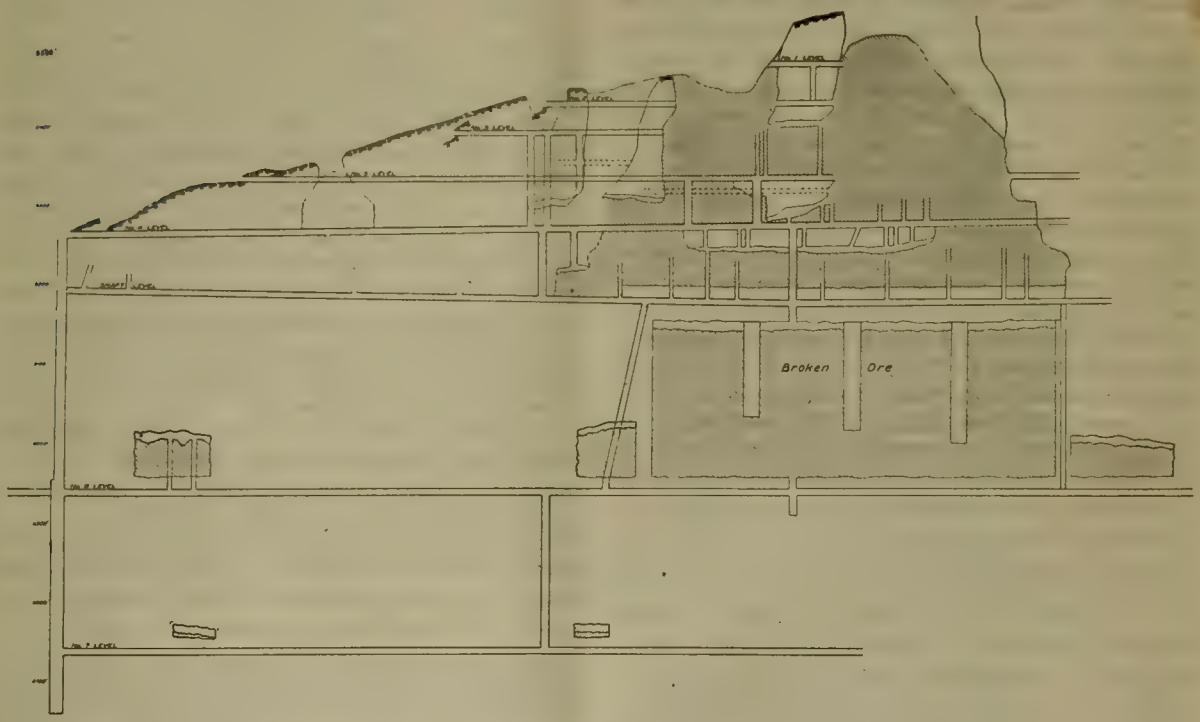
Engels Mine		
Blocked ore:		
In place	1,075,807	
Broken ore in stopes	273,554	
Total		1,349,361
Probable ore		350,000
Total blocked and probable ore		1,699,361
Superior Mine		
Blocked ore:		
In place	363,000	
Broken ore in stopes	108,929	
Total		471,929
Probable ore		100,000
Total blocked and probable ore		571,929
Total		2,271,290

The following data show the cost of production during 1920. The record is excellent when the general high cost of operation is considered in conjunction with the comparatively low grade of the ore (2.21% copper) and the small tonnage (averaging only 657 tons per day) of the output.

	Total cost	Cost per pound of copper, cents
Concentrate on cars at Engels	$1,077,837.93	12.57
Freight and smelting charges $496,407.62		
Credit—gold and silver 145,266.07	351,141.55	4.10
Operating and marketing cost	$1,428,979.48	16.67
Add depreciation and insurance reserve	111,851.64	1.30
Net cost copper production	$1,540,831.12	17.97

A material reduction in the cost per pound has been made since January 1; for May the figure corresponding to 16.67c. in the table was only 13.47c.

GEOLOGY. The country-rock is massive diorite or quartz-diorite comparatively dark and of medium texture. The orebodies are lenses or masses of altered



SECTION OF THE UPPER OR ENGELS MINE. THE NEW ADIT WILL TAP THE WORKINGS 490 FT. BELOW NO. 7 LEVEL

diorite in which the copperbearing minerals are found in veinlets or as disseminated grains. The gangue includes hornblende, chlorite, sericite, epidote, and calcite. Siderite is prevalent and magnetite is generally distributed in the ore. Some tetrahedrite probably accounts for the presence of several ounces of silver in the concentrate. The principal copper minerals are bornite and chalcopyrite, presumably of contemporaneous origin; chalcocite and covellite, from secondary enrichment; also malachite and chrysocolla. The last two are found only in the oxidized zone near the surface and are not of importance. Pyrite is conspicuous by its absence.

Certain questions as to the genesis of the ore in the Engels mine were the basis of a friendly controversy years ago between W. H. Turner and A. P. Rodgers* on one side and L. C. Graton and D. H. McLaughlin† on the other. Turner and Rodgers contended (*a*) that the sulphides were deposited during late stages of the magmatic period, and (*b*) that the chalcocite resulted from the action of ascending hot alkaline waters, thus producing "what may be called ascending (secondary) enrichment". Graton and McLaughlin demurred to both of these conclusions. They contended that, instead of being initial constituents of the dioritic rock, the copperbearing minerals "were introduced after the rock had solidified and had suffered notable dynamic and chemical changes"; also that all of the chalcocite and most of the covellite was accounted for by the normal and generally accepted process of secondary enrichment accomplished by descending surface waters. The importance of this last point is obvious: as pointed out by Graton and McLaughlin, in consequence of this general assumption "operations and plans, whether mining, metallurgical, or financial, are based more or less directly on the expectation that at some depth, commonly not very great, below the surface" deposits of chalcocite ore will be exhausted. If, on the other hand, it can be proved that in certain mines the formation of chalcocite by secondary enrichment has been independent of surface influences, but, instead, "is the result of agencies from deep-seated sources", or, stated otherwise, has resulted from the action of rising or ascending waters, there is need for a decided revision of our ideas concerning this important mineral from which comes so large a part of the world's supply of copper.

Turner and Rodgers entertained their theory for some time before they finally presented the Engels deposit as the best example and as the definite proof; they advanced much plausible detailed mineralogic evidence in support of their view. However, recent disclosures on the lowest levels, of the mines, entirely independent of any inductive reasoning, seem to prove conclusively that Turner and Rodgers were wrong. This evidence is simply the finding in the main orebody of large quantities of bornite with an entire absence of associated chalcocite. This controversy and the apparent conclusion have an interest out of proportion to the importance of these comparatively small orebodies for the reason that if 'ascending secondary enrichment' were to be recognized in one deposit, the same phenomenon might reasonably be expected elsewhere.

The principal differences between the orebodies in the Superior mine and those in the Engels are as follows: At the Superior a more clearly defined lode from 12 to 20 ft. thick and with a dip of from 30° to 45° as compared, at the Engels, with an approximately vertical mass, roughly 750 ft. long and from 25 to 125 ft. wide, in which the ore merges irregularly into the country-rock. Chalcocite and magnetite are less in evidence in the Superior ore; the copperbearing minerals are more inclined to appear as filling in small veins or fractures than as scattered grains.

MINING. Operations at the Engels mine are conducted through two adits and a vertical shaft, known as No. 2, sunk near the portal of 'shaft-level' adit. The 6th-level adit is 240 ft. below the shaft-level and enters the hill at a point 1700 ft. from the shaft; at its portal is the rock-breaker plant and the loading terminal of a 10,000-ft. aerial tramway that carries all the ore down the canyon to the mill. The ground around No. 1 shaft and those portions of the old ore-zone entered by adits known as the 1st, 2nd, and 3rd levels are now caved; a large glory-hole marks the locality of the caved workings. This is indicated clearly on the accompanying longitudinal vertical projection, which, however, does not show the portion of the 6th level that leads from the shaft to the portal. Ore is being mined from stopes above both the 4th and the shaft levels, but 50% of the output during 1920 came from the main stope above the 6th level, and this proportion will be largely increased during the present year; also stoping will be commenced on the 7th level.

The present arrangement is to hoist ore from the 7th level through No. 2 shaft to a pocket above the 6th, where it is to be re-loaded for electric haulage to the portal. Within the next two years a new adit, 7000 ft. long, will be driven to tap the orebody at a point 490 ft. below the present 7th level. This plan has been under consideration since 1917, but the high cost of operation, the difficulty of obtaining miners, and other obstacles have delayed the work. The portal of the new adit will be down the canyon near the site of the old smelter, the plan being to continue the mine tracks as a surface electric tramway to deliver the ore directly into the mill-bins, thereby avoiding the use of any aerial tram. Other apparent advantages are the draining of the mine to a level 700 ft. lower than the present adit, thereby doing away with pumping; improved ventilation for the entire mine; and the deep exploration of a large area of ground hitherto prospected on the surface only.

A considerable tonnage of good ore in the upper levels can never be obtained. It appears that much of the caving was permitted deliberately; this was done on the theory that the dilution of 2% ore with a large proportion of material that assayed from 0.2% to 1.0% would still leave a mixture that could be mined and milled profitably. It was the intention to draw the entire caved block from chutes on the shaft-level. Apparently those

*'Economic Geology', Vol. IX, No. 4.

†'Economic Geology', Vol. XII, No. 1; Vol. XIII, No. 2.

who preceded Mr. Kenzie in charge were deceived as to the copper content of the low-grade material and as to the quantity that was to be used as a diluent.

Operations at the Superior mine are carried on through two adits at elevations 200 ft. apart and a vertical three-compartment shaft at the collar of which is erected a steel head-frame 108 ft. high, built by the Mortensen Construction Co., of San Francisco. Five-ton steel skips hoisted through this main shaft dump directly into the coarse-ore bin at the head of the new mill, joining the ore delivered by the aerial tramway from the Engels mine. If this shaft were continued vertically beyond the lower of the present adits the distance to the orebodies on the deeper levels would be excessive; accordingly it is planned to commence an incline from the existing sump into the hill. A diamond-drill hole 800 ft. long from the end of the main or upper tunnel has revealed the presence of promising ground beyond the present face, which is 1000 ft. from the portal.

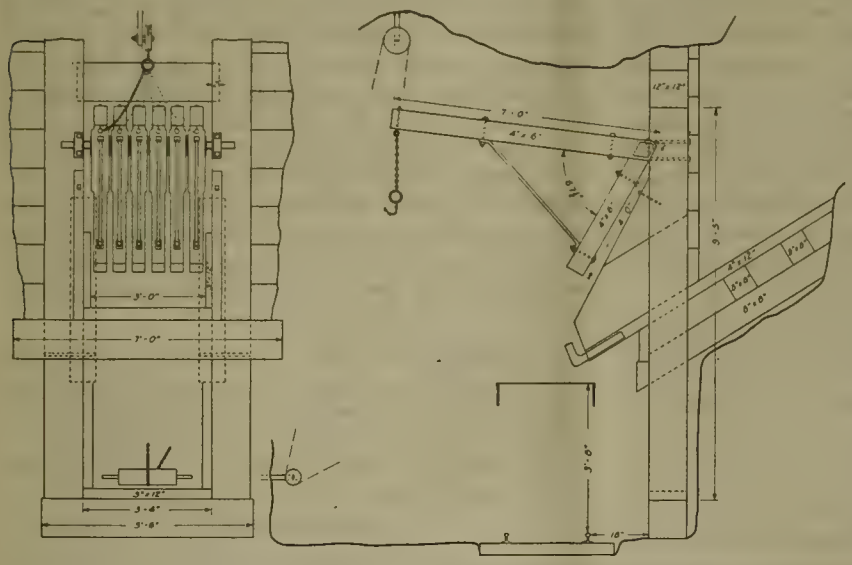


FIG. 2. FINGER-CHUTE USED IN THE ENGELS MINE

SHRINKAGE STOPING. The ground is remarkably firm and solid, and the backs hold well without timber. This characteristic, together with the fact that the orebodies are from 25 to 75 ft. thick, with nearly vertical sides, offers ideal conditions for shrinkage stoping, the system that has always been used in mining the larger blocks of ore in the Engels mine. In his first annual report (1919) Mr. Kinzie gives a concise general description of shrinkage stoping that is worthy of reproduction. He says: "By this method, the orebody to be mined is first undercut throughout its entire area, with the exception of that portion reserved for pillars. The ore thus broken is entirely drawn out through chutes connecting through the bottom of the stope with the level. The work of stoping is then carried on by drilling and blasting the ore from the back of the stopes. After the ore is blasted from the solid backs, the broken ore occupies one-third more space, and as a result one-third of the broken ore has to be drawn off to make room for the stoping operations to be continued. The machine-drills are then set up on top of the broken ore, and the drilling, blasting, and drawing-off of one-third the ore broken is repeated. This work is continued until the stope has been carried up to the next higher level and completed. The stope so finished now contains two-thirds of the ore broken during the period of stoping, and one-third of the ore broken has been drawn off and milled. As soon as the stope is finished, all of the broken ore it contains can be drawn off and utilized. The advantage of this method of stoping is its cheapness, as all timbering and staging are eliminated, and deep drilling and heavy blasting can be used. Its disadvantage is that two-thirds of the ore broken in the stopes is not available for the mills until the stopes are completed. In the case of the Engels mine, where the vertical distance between the No. 6 and shaft-level is 240 ft., it means that two-thirds of the ore broken in the No. 6 level stopes will not be available for from two to three years from the time of starting the work of stoping. It also means that two-thirds of the cost of mining has to be carried in suspense until such time as the ore becomes available. If the development work in a mine has been properly planned and carried out, there should be at least three working levels. On the upper ones, the stopes will have been completed and the work of drawing the broken ore is under way. On the next lower level the development work should have been completed and stoping started; and on the bottom level the work of driving drifts, cross-cuts, etc., to determine the size and value of the orebodies and preparing for future stopes, should be in progress."

Certain changes made in the method from time to time and the reasons therefor may be of interest. The original method of loading cars was by hand-shoveling from the floor of small chambers off-set from the main drift. This method, of course, was expensive but had the advantage of making unnecessary any considerable pillar above the drift-level. Some timber was saved, but this was not an important consideration in a locality where the trees had only to be cut to supply excellent timber. For the stopes above the 6th level, loading-chutes of 4-in. plank were built; these were fitted with chute-mouths and arc-gates, and four feet above were placed grizzleys of old rail. This formed the floor of a bulldozing-chamber where large rocks were block-holed with 'jackhamers'; the stope funneled into the chamber. The objections to this method were: (a) loading through the arc-gates was slow and (b) a sheet-pillar averaging 35 ft. in height above the floor of the drift was necessarily left. New chutes on the

6th and 7th levels are not provided with bulldozing-chambers; instead, the stoped ore is allowed to fill the entire space behind specially built finger-chutes similar to those used at the Treadwell mine in Alaska. See Fig. 2. Some block-holing will be necessary in the stopes as mining progresses but the scheme will obviate the first difficulties mentioned as applying to the former method, and will permit a saving of 15 to 20 ft. in the height of the sheet-pillar.

Formerly no vertical pillars were left in the stopes, but cribbed manways at intervals of 50 ft. were raised as the stopes advanced to afford access for the miners. In the upper levels where the 'lift' was only about 60 ft., as between the 5th and 3rd, it was possible to keep these manways open until the block had been mined; when the attempt was made to carry out the same plan in mining the ore between the 6th level and the shaft-level the maintenance of cribbed manways in the broken ore was found to be not only impracticable but virtually impossible, and they were necessarily abandoned after a height of 80 ft. was reached. None will be started on the 7th level. Mr. Kinzie also decided to divide the main 6th-level stope, then about 500 ft. long, into four blocks by leaving 20-ft. pillars alternating with stopes 120 ft. long. This can be seen in Fig. 1; the pillars start from the vertical height reached in June 1919.

The 6th-level stopes are not to be completed to the floor of the shaft-level; on the contrary, there is to be left a sheet-pillar, which, including the ground immediately above the level, will be 50 ft. thick. The necessity for leaving this pillar arises from the condition of the upper levels as already described. Were it not for the dilution of barren and low-grade rock it would be desirable to let the caved ore in the upper workings follow down through the lower stopes. Under the circumstances the flow must be stopped somewhere, and the sheet-pillar at the shaft-level is designed to effect this purpose.

The interval between levels considered to be most advantageous is 200 ft., which accordingly is the lift from the 7th to the 6th level. Here the stopes will be started according to the ideal plan. The finger-chutes are to be placed at intervals of from 15 to 25 ft. on opposite sides of the level-drift. Pillars 20 ft. wide will alternate with 120-ft. stopes; in every second pillar will be a permanent manway-raise driven through to the level above. At vertical intervals of 20 to 25 ft. the manway-drift will connect with, and afford communication to, adjacent stopes. At one point, where the orebody is unusually wide, foot-wall and hanging-wall working-drifts will parallel each other for some distance, finally making a junction and continuing as one drift.

One third of the ore broken is drawn as the stope advances, two thirds remaining to be removed subsequently. Approximately 300,000 tons of broken ore will be available in the 6th-level stope, the raising of which is now nearing completion, whereas 150,000 tons will have been removed and milled during the ore-breaking period. Arched backs are carried to minimize the possibility of caving. Holes are drilled horizontally with drills mounted on vertical columns, with a view to obtaining the maximum efficiency in drilling and breaking. The importance of a clean back from the standpoint of safety should be emphasized; it is a fixed policy of the company to take every reasonable precaution against injury of its employees. Square sets are used occasionally in some of the old stopes on the upper levels but it would not be accurate to say that systematic square-set mining is done.

In the Superior mine, shrinkage methods are not generally suitable on account of the comparative flatness of the walls; the slope is approximately 45°. The orebodies are only from 10 to 20 ft. thick and accordingly they can be mined successfully by overhand breast-stoping. A few stulls are used and occasionally a pillar is left to afford additional support, although the back is exceptionally solid and causes little trouble. Wall-pillars as well as post-pillars can generally be left conveniently in places where the ore is comparatively poor. In one stope foot-wall chutes have been raised from auxiliary drifts on the haulage level, parallel to and 25 to 35 ft. from the main drift, in order to draw the ore, which does not 'run' at the flat angle of the foot-wall. Drifts and long raises in barren rock, however, are expensive and as the stopes become higher steel scrapers are to be used to move the ore into the chutes. These will be operated by a tugger-hoist and light cable so arranged that the hoist can be utilized to pull the scraper back, up the stope.

Underground Equipment. Both storage-battery and trolley locomotives are used underground; the former are employed in gathering cars and the latter for haulage in the main adit on the 6th level. The trolley-locomotives are a 4-ton Baldwin-Westinghouse and a 3-ton General Electric machine each capable of pulling trains of 15 to 20 cars. The storage-battery machines are unable to duplicate the performance of the trolley-locomotives but have the advantage of the flexibility required in the work for which they are used. This division of labor has much to commend it. Side-dumping steel cars of the cradle type have been improved by substituting a solid wooden base bound with wide strap-iron for the original fabricated structural-steel base. The constant bumping of the cars as the trains were pulled or pushed resulted in the cracking of the steel, whereas the solid wood seemed to absorb the shock without injury. All the cars are now supplied with wooden bases made at the mine.

The following is a list of the explosives used: in the stopes, 25% gelatine; for raising and other development work, 40% gelatine with some 60%; Coast Manufacturing Co.'s Bear brand fuse for dry holes and triple-tape fuse, water-proofed at the cap-joint with P. & B. paint, for wet holes; No. 6 caps for plugging and block-holing; No. 8 caps in the stopes; and Ideal delay-action electric exploders, supplied by the California Cap Co., for development work. No firing-box is used for the exploders, the current being taken from the electric-light circuit.

Hercules tamping-bags are used; these are made of the same paper as is used to wrap dynamite instead of the flimsy wrapping paper of which they were formerly made. They are easy to fill with clay or tailing; they are

not liable to break, and, according to Mr. Lindsay, the miners are actually using them, with a consequent material saving of powder. Many superintendents have experienced difficulty in getting their miners to use tamping material; I believe that the use of these tough paper containers ought to lessen the difficulty. During 1920 a total of 337,700 lb. of powder was consumed in breaking 327,491 tons of ore, or 1.03 lb. per ton. The cost of powder averaged $0.20 per pound delivered at Engels, making the cost per ton of ore broken $0.206. Including waste broken, the consumption of powder was 0.97 lb. per ton of rock. The cost of caps and fuse was $0.053 per ton of ore.

A variety of rock-drills has been in use, but it has been decided to standardize by discarding all but three types of drill, these being of Ingersoll-Rand manufacture. They are the new '448' drill for all work where bars or columns are employed; 'L 40', a self-rotating hammer-drill using hollow steel and water, for raising; and 'jack-hamers' for block-holing. The only 'dry' drills except jackhamers now in use are a few 'CC11' stopers, but these will be scrapped in keeping with the company's policy of making working conditions as safe and healthful as possible. The following data show the results of machine-drilling during the year 1920 in the two mines:

	*Average number machine-shifts			Holes drilled per machine shift	Average depth of hole	†Average number ft. drilled per machine-shift	Tons of rock broken per machine-shift		
Engels mine:	Mining	Development	Total				Mining	Development	Total
4th level	5.61	2.86	8.47	...	...	...	11.6	5.7	10.2
Shaft level	2.65	1.61	4.26	...	..	...	8.8	10.4	9.4
6th level	21.83	4.62	26.45	...	...	...	31.9	5.2	26.0
7th level and shaft	...	1.89	1.89	...	..	...	...	10.3	10.3
Totals and averages	30.09	10.98	41.07	6.1	5.3	32.1	25.0	7.5	19.5
Superior mine:									
1st level	12.42	3.04	15.46	...	...	...	19.8	6.0	16.9
2nd level	1.70	2.07	3.77	...	...	...	12.8	7.3	9.7
Totals and averages	14.12	5.11	19.23	5.8	5.1	29.8	18.9	6.5	15.3

*Including pluggers. †Not including pluggers.

It is interesting to note that, whereas the table shows 31.9 tons broken per machine-shift on the 6th level during 1920, the average for the last five months of the year was 40.8 tons. Increased individual efficiency of the miners and better systematization throughout the mine are assigned by Mr. Lindsay as the reasons for this improvement.

The consumption of drill-steel, including pieces lost and discarded, during 1920 amounted to 65,480 lb., or 0.2 lb. per ton of ore broken. The average price delivered at Engels was $0.19 per pound, making the cost of steel $0.038 per ton of ore broken. This was equivalent to a cost of $0.57 per machine-shift for drill-steel. These figures may seem high, but in making any comparison with results obtained elsewhere the hardness and toughness of the rock at Engels should be taken into account.

SURFACE EQUIPMENT. The main hoist at the Engels shaft was made by the Nordberg Manufacturing Co. It is a double-drum machine actuated by a 150-hp. General Electric alternating-current motor, operating at 2200 volts and a speed of 500 r.p.m. It is connected to the hoist through a flexible coupling and herringbone gears. The clutch and brakes are operated by air. A novel chain-driven ball-governor automatically limits the speed of hoisting. It may be adjusted for any desired rope-speed; if this be exceeded the brakes are automatically set with a suddenness that is uncomfortable to anyone riding on the cage, an occurrence that a good hoist-engineer avoids carefully. The hoist cannot over-wind. One unusual thing about the hoist is worthy of mention for the reason that it calls attention to a mistake that has been made at more than one mine. The drums of the hoist have been shortened by inserting wooden fillers at the outside end. The purpose is to decrease the horizontal displacement of the ropes from alignment with the sheave-wheels, thereby lessening the wear on the strands caused by rubbing on the rims of the wheels. The mistake was this: When the plant was erected the hoist was placed only about 50 ft. from the collar of the shaft, although there was no good reason why the hoist-house could not have been 150 to 250 ft. farther away, thereby lessening the angle at which the rope approaches the sheave, when at the extreme positions on the drum. This would have added materially to the life of the ropes with consequent economy in operations.

A Lidgerwood hoist, designed to operate by water-wheel at the Harvard mine at Jamestown, California, has been re-built for use at the Superior shaft. It is connected through two Falk herringbone-gears, running in oil, and an intermediate counter-shaft to a 250-hp. 440-volt General Electric induction motor. A feature of the re-built hoist is the arrangement of the brakes. In addition to hand-brakes on the drums, two post-brakes are provided; of these one is on the motor-shaft, which overhangs the bearing, and the other is on the counter-shaft. This arrangement effectively relieves the transmission machinery of the strain that otherwise would be thrown upon it and makes the operation smooth and readily controlled.

Adjoining the Engels hoist-room is the steel-sharpening shop, equipped throughout with Ingersoll-Rand machines, including a fuel-oil furnace, one No. 5 Leyner sharpener, and a punch for use with hollow steel. One man and a helper sharpen, cool, re-heat, and temper 500 pieces per shift under average conditions. At the Superior mine two No. 4 sharpeners are substituted for the No. 5; otherwise the shops are alike.

The compressor plants, one at each mine, are interesting from the fact that each contains an Imperial Type 10 Ingersoll-Rand machine that originally supplied air for the driving of the McAdoo tubes under the Hudson river. Each compressor has a capacity of 2300 cu. ft. per minute; the cylinders are 28 and 17 in. by 24 in.; and

each is connected to a 400-hp. motor by a 40-in. three-ply Reliance leather belt made by the Chicago Belting Co. The use of these high-priced leather belts, costing in the neighborhood of $4000 each, is interesting for the reason that it illustrates the ultimate economy of incurring high initial cost if it promises long life, steady operation, and low maintenance. The compressor at the Engels mine at Upper Camp ran 24 hours per day continuously for eight months without being shut-down even temporarily, I am informed. Both Imperial Type 10 compressors are run by Allis-Chalmers synchronous motors. In the Engels plant are a motor-driven 750-ft. Sullivan compressor, Class WJ3, and an old steam-compressor that has been connected to run by motor. This machine was made by the Ingersoll-Rand company and saw service for a short time at the Mare Island Navy Yard; nevertheless it still supplies its rated capacity of 1000 cu. ft. per minute quite satisfactorily. At the Superior plant a small angle-type Sullivan compressor serves as an auxiliary.

As already stated, the ore issues from the Engels mine through the 6th-level adit; electric locomotives pull the mine-cars over the storage-bin of the rock-breaking plant where it passes through in a Blake-type jaw-crusher with a maximum opening of five inches. The run-of-mine product contains a great many chunks that weigh from 100 to 200 lb. so that it is essential that the material be broken before it can be loaded into the buckets of the aerial tram that carries it down to the concentrator. The rock-breaking plant is interesting and efficient; it will be described in a second article, dealing with the milling operations.

The tramway was erected by the Riblet Tramway Co. of Spokane, Washington, during the winter of 1917-1918, when the new mill was built. It is 10,000 ft. long and the loading-station is 700 ft. higher than the top of the mill-bins into which the buckets discharge. The track-cables are of the locked-coil type, the present cable being supplied by the American Steel Products Co.; the cable carrying the loaded buckets is $1\frac{3}{8}$ in diam., whereas the track for the up-going buckets is $\frac{7}{8}$ in. The running or traction cable now in use is $\frac{5}{8}$ in. diam. Thirty-two towers support the cable and two intermediate tension-stations divide the track-cables into three approximately equal segments. There are 48 buckets, each with a capacity of 1100 lb. of ore; at normal speed the tram can deliver 500 to 600 tons of ore per day. The track-cable that was purchased at the time the tramway was projected suffered the fate of much other material in that the Government commandeered it after shipment had actually been made. Mr. Paxton, with characteristic resourcefulness, negotiated the purchase of a quantity of second-hand cable that had been used at a mining property in Arizona. Recently, this has been replaced by new cable.

The original traction cable was only $\frac{1}{2}$ in. diam. as compared with $\frac{5}{8}$ in. now used. This was too light for the work and frequent breaks resulted; the buckets would then collect in groups at points where the track-cable sagged. The task of repairing the cable and restoring operation was not only costly, in that it required a large force of men, but it delayed haulage and frequently caused temporary shut-downs of the mill.

Trouble has always been experienced with the grips by which the buckets are attached to the running-cable, although the profile of the line is comparatively smooth and is not excessively steep. The original grips, designed for a $\frac{1}{2}$-in. cable, failed to remain securely locked and slipped badly; this slipping, and the consequent wear, naturally aggravated the tendency of the cable to break. It was thought possible that the trouble from slipping would be overcome by substituting the larger cable and correspondingly larger grips, but even then the automatic locking device did not seem to function adequately. In an effort to remedy this trouble an extension was devised for the locking-arm at each of the terminals, whereby a longer, harder, and smoother pressure was applied to the grip-lever, by means of a long gently curving strip of boiler-plate forced down by sundry improvised springs. Marked improvement is noted but O. B. Camp, master mechanic for the company, is convinced that his own difficulties would be lessened and more regular operation obtained if he had a tramway in which the buckets were permanently attached by means of a clip to the traction-cable. It may be remarked that, though unusual, a number of such trams have been built, and operated successfully. The advantages are the impossibility of unlocking or slipping of the grips; and the uniform balance that results from having the buckets exactly spaced at all times. The disadvantage lies in the necessity for providing a moving chute for loading the buckets as they pass through the terminal without stopping. Any hitch or delay in the mechanism may result in the departure of an empty or a half-filled bucket. On the whole a properly designed grip is probably more desirable. It is not fair to condemn the Riblet grip because it gives trouble in this particular tram, for the reason that similar grips are working satisfactorily elsewhere. Just what the conditions are that cause the difficulty at Engels are not known.

Prior to September 1920 the per-ton mining costs were based on the quantity of ore milled. Starting with that month the basis was changed to 'tons of ore broken'. The following analysis of the cost covers, therefore, the last four months of 1920 only. During that period 142,402 tons of ore was mined and 86,021 tons was milled, leaving a net increase of stoped ore amounting to 56,382 tons. The figures, based on 142,403 tons, are as follows:

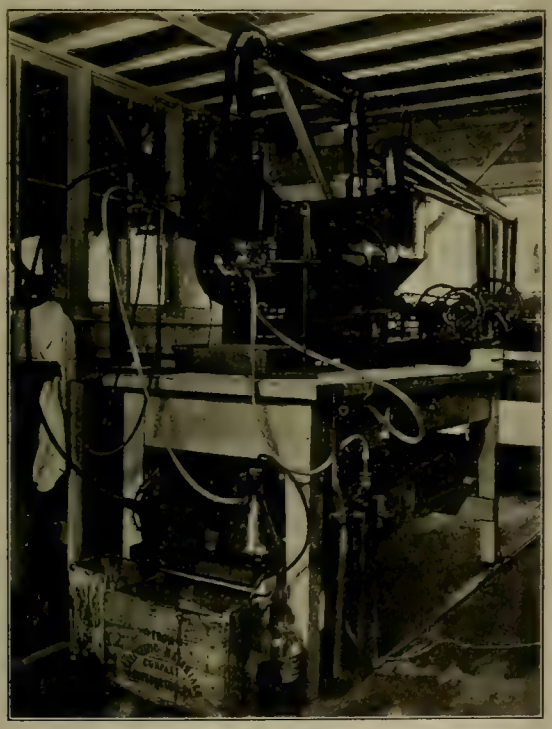
	Cost per ton		
Item	Labor	Supplies	Total
Machine drilling	$0.5524	$0.1673	$0.7197
Shoveling and tramming	0.3793	0.0227	0.4020
Explosives	0.0197	0.2077	0.2274
Timbering	0.0867	0.0412	0.1279
Track and pipe	0.0189	0.0245	0.0434
Carbide and candles	.....	0.0089	0.0089
Assaying	0.0122	0.0089	0.0211
Engineering	0.0112	0.0019	0.0131
General	0.0083	0.0035	0.0118
Loss on boarding-house	.....	0.1304	0.1304
Total	$1.0887	$0.6170	$1.7057

(To be Concluded)

Chloride Volatilization Process

By Thomas Varley and C. C. Stevenson

*The chloride volatilization process is still in the experimental stage. The process has not been sufficiently developed to permit us to state definitely what place it will occupy in the metallurgical industry; the theory upon which it operates has received the attention of prominent metallurgists for the past twenty years, but the results of much of the experimental work done have not been published. The object of this paper is to bring the salient features of the process to the attention of the industry, for the purpose of furnishing information and to encourage comment. A bulletin covering the work done at the Intermountain experiment station of the U. S. Bureau of Mines, at Salt Lake City, Utah, is in course of preparation.



LABORATORY KILN, WITH CHLORIDE INJECTOR AND BURNER

SCREW-FEEDER FOR LABORATORY KILN

The chloridizing roast is usually accompanied by appreciable losses, due to the volatilization of the metals as chlorides, these losses often running as high as 30%, depending upon the temperature, the character of the ores, and the associated gangue material. It was not until 1891 that Croasdale,† by observing flue and stack deposits from the chloridizing roast, recognized the possibility of making volatilization a major instead of a minor feature of the roast. He then made tests on a number of ores from different localities, the result of which showed the general application of the process. The main difficulty, as stated by Croasdale, was the lack of a suitable means for recovering the fume from the furnace gases. In 1913, Cottrell‡ announced his invention of the electrostatic precipitator, which solved the problem of separating the solids from the furnace gases. About 1915 O. C. Ralston, of the U. S. Bureau of Mines, began an investigation of the chloride volatilization process as a possible means of ore-treatment. Since that time the Intermountain station of the Bureau, in co-operation with the department of metallurgical research of the University of Utah, has gone extensively into the problem.

POSSIBILITIES OF THE PROCESS. The process is adapted to the treatment of oxidized, semi-oxidized, and carbonate ores of copper, lead, and silver, which are difficult to treat by gravity concentration or flotation.

*Abstracted from Serial No. 2247, U. S. Bureau of Mines.

†'E. & M. J.', Aug. 29, 1903.

‡'M. & S. P.', March 29, 1913; also Trans. A. I. M. E., Sept. 1918.

Gold that is present in ores has been readily volatilized. Zinc does not volatilize if an oxidizing condition is maintained. Excellent results have been obtained on zinc concentrate containing silver and lead; practically all the silver and lead have been volatilized, but little zinc. Experiments have shown that this is probably one of the best methods of making a clean-cut separation of lead and zinc. No great amount of work has been done on sulphide ores, the need of such a method for the oxidized and carbonate ores is more pressing. Experiments, however, carried out on sulphides are encouraging. When the sulphur content is more than about 5%, a preliminary roast is usually necessary.

Methods of Experimentation. The ores are analyzed for their chemical and mineralogical constituents, the latter by the microscope in order to identify and determine the physical condition of the minerals. The chemical analysis reveals the various amounts of metals present, and the microscopic analysis shows in what minerals the metals occur—it is possible to determine accurately the size of crushing necessary to liberate from the gangue the greatest amount of mineral that can be recovered economically. The compactness or porosity of the ores in which the minerals occur is an important factor, the compact ores usually require finer crushing. After the degree to which the ore must be crushed has been determined, it is necessary to calculate, from assays and analyses, the amount of chloridizing salts that must be added to the charge, to ensure the presence of sufficient chlorine to unite with the metals and to effect complete chloridation and volatilization.

Muffle-Tests. The assay muffle is usually used for this preliminary determination. Temperature varies with different ores, but when silver is present about 1050°C. is usually required; 100 gm. of crushed ore is mixed with a certain percentage of salt or calcium chloride. A number of such charges, contained in 5-in. or 6-in. roasting dishes, are then placed in the heated furnace. Several tests are made in which the varying factors are time of roast, temperature of furnace, fineness of crushing of ores, and amounts of salt and calcium chloride. The residues after roasting are weighed and assayed, and from these results the percentage of volatilization is calculated. In these experiments none of the fumes evolved can be caught.

Electric-Tube Tests. Tests are made by means of a horizontal electric furnace; a small boat containing the mixed charges is placed in a silica or porcelain tube, and then the tube is placed in the furnace. It is possible to pass air through the tube at any desired rate and also to collect the fumes and measure the gases.

Laboratory Volatilization-Plant. The plant consists of a rotary kiln, dust-chambers, a double-unit electrostatic-precipitator, and a Stevenson chloride-injector, constituting a complete miniature chloride-volatilization plant. The kiln has three speeds, either one, two, or three r.p.m. The speed affects capacity, ore transit rate, and dusting. The ore-feeder is equipped with eight different speeds, which permit variation in the rate of feeding the ore from about 1½ to 12 lb. per hour. The rate of feed affects the capacity and length of time that the ore is in the furnace. The velocity of the gases is regulated by means of slide dampers arranged in the channels that convey the gas. The gas velocity affects the dusting, grade of fume produced, and the concentration of the chloridizing atmosphere in the furnace. The chloride injector has 48 different speeds, which will feed from 2½ to about 20 oz. of chloridizing reagents per hour. This large variation makes it possible to supply almost any desired quantity of chloridizing reagents to the ore in the heated zone of the furnace.

The treaters are constructed in two separate units of four and two pipes, respectively. These units may be used separately or collectively, which is equivalent to using either a two-, four-, or six-tube treater. The number of tubes used affects the velocity of the gas in the treaters and the clearance. The furnace is fired with a blow-torch, using artificial illuminating gas under low pressure, or oil and air at about 20-lb. pressure. The control of the temperature is satisfactory, any desired heat up to 1250°C. being maintained without difficulty.

Tests are made in the small laboratory plant both for research investigations and as preliminaries to the large-kiln tests. From 10 to 25-lb. samples are desirable for these experiments. The ore, with part of the chloridizing reagents, is fed into the upper end of the furnace by means of a mechanical ore-feeder; the remaining portion of the chloridizing reagents is injected directly onto the charge in the front or heated end of the furnace.

The large-kiln tests are usually preceded by a number of preliminary small-kiln tests, in order to determine a set of conditions that are most effective for the ore to be treated. From 200 to 2000 lb. of ore is usually employed in making these final tests. The following results are typical:

	Per cent volatilized Small kiln		Per cent volatilized Large kiln	
	Silver	Lead	Silver	Lead
Carbonate silver-lead ore.....	93	94	90	88
Oxidized silver-lead ore	85	94	90	92

The first tests made in the small furnace were conducted for the purpose of improving the extraction of silver from an ore of approximately the following analysis: 7.4% lead, and 6.80 oz. silver per ton. Previous work had been done on this ore, resulting in good extraction of the lead, but the result on silver was unsatisfactory, 60 to 65% being the best obtainable. The usual method of making volatilization tests is to mix the ore with the chloridizing reagent or reagents, and to feed the mixture by a screw-feeder or other suitable means into the cool end of the furnace. The rotation of the kiln and the slope of the frame on which the furnace is mounted causes the charge to migrate downward toward the front and heated end. When the charge becomes heated a reaction takes place between the metal-bearing minerals and the chloridizing reagent, which effects a chloridization of the metals with a subsequent evaporation of the metal haloid.

Chemical Reactions. There seems to be a difference of opinion as to the most probable chemical reactions that

take place. It is our opinion that different reactions are involved, depending on the chloridizing conditions brought about in the furnace. The three following equations show the reactions that are most likely to take place, assuming silver as the metal to be chloridized and volatilized.

No. 1 (According to Croasdale):

$$Ag_2S + 2O_2 = Ag_2SO_4$$
$$2NaCl + Ag_2SO_4 = 2AgCl + Na_2SO_4$$

In the presence of sulphates, this reaction would in all probability take place during some stage of the roast.

Experiments have shown that silver, lead, and other metals can be chloridized and volatilized in the absence of sulphur. This reaction, represented by Equation 2, would take place to some degree, provided that the temperature were high enough and all the salt had not volatilized as sodium chloride before the charge could reach the temperature necessary to promote the reaction; *R* represents the metal volatilized.

No. 2:

$$RO + 2NaCl = Na_2O + RCl_2$$

It is doubtful whether this reaction would take place if the sodium oxide had nothing with which to combine. It is known that sodium oxide is difficult to form; however, if silicates in the gangue are available for combining with sodium oxide, to form a sodium silicate, it is possible to get a reaction with part of the salt. The following reaction represents the chloridizing of most of the metals present in an oxidized ore.

No. 3:

$$2NaCl + SiO_2 + H_2O + Heat = Na_2SiO_3 + 2HCl$$
$$4HCl + O_2 \leftrightarrows 2H_2O + 2Cl_2$$

On the assumption that the equations given are correct—even to the complete chloridization of all the silver in the ore at some time during the thermal treatment—there remains a condition that would be likely to prevent complete volatilization of the silver. Is the metal volatilized immediately upon being chloridized or is a certain time required for the metal haloid to evaporate? The action of the chloridizing roast preparatory to leaching is sufficient evidence that the chlorides are formed at relatively low temperatures and without being completely evaporated.

The following reaction could be expected to occur with at least part of the metal haloid at increased temperature.

$$2RCl_2 + O_2 + Heat \leftrightarrows 2RO + Cl_2$$

As the charge passes through the furnace, the temperature continues to increase, and part of the salt rapidly volatilizes as sodium chloride, while the remainder enters into the chloridizing reactions. The result is that the metallic chloride, which does not evaporate rapidly in the zones of lower temperature, is conveyed into the hotter regions, where the chloridizing atmosphere becomes lean. It would not require a strong imagination to conceive a decomposition or reversal of reaction, in which the metal would be left with the calcine as a non-volatile compound or element. Experiments have shown that the silver remaining in the calcine from a high-temperature roast (1000° C.) is not present as chloride.

It may be that some of the silver compounds occurring in the complex oxidized ores are not chloridized at the low temperature. If this were the case, it could logically be assumed that the chloridizing reagent or reagents might be volatilized or decomposed and dissipated before the silver would be in an available state to be chloridized.

COTTRELL APPARATUS

From this reasoning, it appears that the most logical method of volatilizing metals from an ore would be to place the charge, consisting of ore and part of the chloridizing reagents, in the furnace, to permit the charge to become heated to the proper temperature and then to supply the remaining portion of the haloid salt to the heated charge in the zone of high temperature. This method of supplying the chloridizing reagent would produce a highly chloridizing atmosphere directly where it is needed.

The following is the record of the first test made, wherein the chloridizing reagents were supplied to the

charge in the front and heated end. This test was made for the purpose of chloridizing and volatilizing the lead and silver in an oxidized zinc ore, leaving high-grade zinc calcine. The charge was fed into the feed end of the furnace by means of a screw-conveyor. In addition, 4% of hydrated calcium chloride was fed by hand at regular intervals to the charge in the fire-box, instead of introducing it with the charge. The temperature was 1010°C. Steam was passed into the fire-box. Good oxidizing conditions were provided. Dense fumes were evolved, especially when the portions of chloridizing agent were supplied to the charge in the fire-box. The following assays show the result:

	Assay of material			Per cent volatilized	
	Silver	Lead	Zinc	Silver	Lead
	oz.	%	%		
Original ore (10 lb.)	6.8	7.4	32.6	...	...
Calcine before addition of $CaCl_2$, $2H_2O$	1.32	1.58	....	74.3	73.0
Calcine after addition of 4% of $CaCl_2$, $2H_2O$	0.68	0.63	44.86	90.3	92.0

These results are conclusive, and show definitely the advantage of adding part of the chloridizing reagent at the hottest point in the furnace, thereby giving a strong concentration of chlorine vapors at the critical temperature and time at which the chemical reactions take place.

fusion of salts that are later decomposed at the high temperatures. The evaporation of moisture from the ore causes precipitation of the soluble salts and the deposition of suspended matter, both of which act as a binder, and crust the particles of ore together.

The low-temperature fusion of sundry salts—either those contained in the ore, those supplied as chloridizing reagents, or the salts formed from the reactions—serves as a binding medium and causes some trouble in the feed end. Baking forms rings of crusted ore in the feed end of the furnace, which continue to build up on the lining until the ore flows back into the dust-chamber. Baking is not a serious difficulty. The crust is easily broken and a heavy drag or rabble properly placed will prevent its formation.

The rate of ore-travel should be as slow as possible in order to reduce dust-losses and prevent a high insoluble content in the fume. A linear travel of about 15 ft. per minute in a commercial kiln is usually sufficient to mix the charge and maintain the desired capacity. The gas velocity should not exceed the speed necessary to carry away the combustion gases and fume. High velocity causes a high dust loss, low-grade fume, and a dilute

SUMMARY OF RESULTS ON VARIOUS TESTS

	Head Assays						Reagents		Per cent Volatilized		
Ore	Gold oz.	Silver oz.	Lead %	Zinc %	Insoluble %	Sulphur %	NaCl %	$CaCl_2$, $2H_2O$, %	Gold %	Silver %	Lead %
Oxidized zinc concentrate	...	6.80	7.40	32.6	13.6	...	6	6	..	85	80
Oxidized silver-lead ore, Utah	0.07	9.39	15.7	1.25	62.0	4.47	10	10	..	80	89
Silver-lead ore, California	...	9.66	1.07	1.83	56.0	4.92	5	10	..	80	..
Oxidized silver-lead ore, Nevada	0.03	3.56	5.35	...	...	...	5	10	70	87	80
Oxidized silver-lead ore, South America	...	12.0	1.60	...	77.2	0.86	5	7	..	75	80

SINTERING. Sintering is the result of a semi-fusion of the charge that may be caused in several ways. Most frequently the gangue in the ore is so composed as to be self-fluxing; when heated it begins to fuse at a moderately low temperature. A variation of this type of ore would be one composed principally of non-fluxing gangue material, but accompanied by ingredients in the form of dust that would flux the main gangue minerals. Gossan, composed of limonite, hematite, and other iron minerals, would be an example. Sintering is promoted by the chloridizing reagents, common salt being especially active. The salt, upon decomposing, liberates its chlorine and combines possibly as a silicate or sulphate, both of which are fusible at the temperatures required to volatilize silver chloride. Most sulphide ores tend to sinter, which results in sealing the metal within the ore particles and protects it from the chloridizing gases, thus causing low extraction. This objectionable feature is usually overcome by the use of some inert nonfusible material such as limestone. The addition of 5 to 15% of lime-rock will prevent sintering in some of the worst ores. The use of calcium oxide would be still better, because there would be no carbon dioxide to dilute the gases.

BAKING. In making preliminary muffle- or tube-tests, baking and sintering should not be confused. Baking is the result of a crust-forming action in the charge, taking place in the region of lower temperature in the furnace. Two causes are responsible for most of the baking that occurs: the evaporation of moisture, and the temporary

chloridizing atmosphere over the charge in the furnace. A velocity of 10 to 20 ft. per second is usually sufficient in a properly designed kiln. The necessary temperature required for chloridizing and volatilizing the metals from an ore depends entirely on the metals to be volatilized. Copper and lead will volatilize at much lower temperatures than gold and silver. However, a temperature of 1000°C. should completely volatilize all the metals except zinc, providing the charge does not sinter. The time required to evaporate the metal haloids depends on the temperature and concentration of the chloridizing atmosphere. Forty to sixty minutes, under proper temperature and chloridizing conditions, should be sufficient.

SUGAR OF ANTIMONY is used in making furniture polish, and the chloride ($SbCl_3$) is used in the preparation of fireproof preservatives of wood, paper, and textile fabrics, such as creosote, pitch, tar, and asphalt, states a U. S. Geological Survey bulletin. Antimonate of lead, containing an excess of lead oxide, known as Naples yellow, is used in oil paints and in the glass and ceramic industries. Tartar emetic and antimony fluoride are employed as mordants in dyeing. Tartar emetic and antimony trioxide are employed medicinally. Antimonial lead carrying 12 to 13% of antimony is employed in the manufacture of bullets. Antimony sulphide is almost universally used as a constituent of primers in shells and cartridges, and to produce on explosion a dense white smoke, which is of service in range finding.

Repairing a Wood-Stave Pipe-Line

By G. A. Joslin

In 1919 the Ramshorn Mines Co., operating at Bayhorse, in Custer county, Idaho, replaced the old power-plant used in the 'nineties with a modern hydro-electric equipment, which furnishes power for mine and mill. The old open flume, which contoured the steep hillside from dam to head of penstock, gave way to an 18-in. pipe-line laid on the flume grade; at the end of the grade-line pipe a standpipe was placed and a new penstock laid down the hillside to the power-house. All the pipe was machine-banded wood-stave of the inserted-joint type. The drop from dam to head of penstock is 68 ft. and from this point to the power-house is 354 feet.

The original plans called for a cast-iron tee at the junction of the grade-line pipe, standpipe, and penstock, but on the advice of the construction superintendent a reinforced-concrete junction-box was substituted. Construction was carried on with all of the wastefulness, carelessness, and inefficiency of labor for which we blame the War. As a result the concrete box failed late in the fall of 1919. Winter was coming on, time was short, so a wooden box tied together with rails and rods was constructed hastily. This held satisfactorily for a year, but during the winter of 1920-21 was the cause of increasing trouble and was recently replaced by a cast-iron tee and elbows.

Had the grade-line pipe and the penstock been in the same plane and at right angles to each other at their intersection, any standard cast-iron tee would have sufficed, but the penstock came out at the bottom of the box, whereas the grade-line pipe entered at the top, and the two pipes intersected at an obtuse angle when viewed in plan. Wood-stave pipe once laid and set should not be disturbed. The first problem therefore was to find a way of inserting fittings without moving the two pipes. The standpipe being of short length, 180 ft., and easily moved entire, did not affect first considerations. Drawings were made showing the positions of the pipes as they entered the wooden box. A standard long-radius elbow connected to the end of the penstock was laid out and a special tee designed so that the centre-line of its outlet fell in a plane with the centre-line of the penstock, the outlet being designed long enough to take up the offset distance between the two pipes and permit the centre-line of the run of the tee to be a continuation of the centre-line of the grade-line pipe. One run of the tee was designed to connect with the grade-line pipe, the other run with the standpipe, which was laid up the hill on the natural slope to a point of approximately the same elevation as the intake end of the grade-line pipe at the dam, and the outlet to connect with the elbow of the penstock. By being able to turn this elbow about the axis of the penstock and the tee about the axis of the grade-line pipe it was possible to bring the flange of the outlet and the flange of the elbow together without moving the two pipes. The design, of course, required cutting the pipes at the correct distance from the outlet of the tee and from the flange of the elbow to admit the hub-flanges used to connect wood-stave with standard pipe-fittings.

Because of the difficulty of obtaining exact measurements of the pipes as they entered the wooden box, the drawing was not considered sufficiently accurate to use

in marking off the points where the pipes were to be cut. To cut off an inch too much would be serious. To obviate the necessity of lifting the heavy cast-iron fittings into place for a try and cut, wooden forms were made of elbow and tee, and a form for each hub-connector identical with the cast-iron hub as to flange end but having on the hub end a jacob staff to slide into the open pipes. As soon as the wooden junction-box had been dismantled, the wooden forms were placed in position, the staffs of each hub-connector form extended into the pipes, allowance made for the length of the cast-iron hubs, and the pipes marked and cut. The heavy cast-iron fittings were then assembled and slipped into place as simply as a final Euclidean equation. The standpipe was then moved slightly and by means of a second long-radius elbow attached to the run end of the tee opposite the grade-line pipe. The whole job, including the wrecking of the wooden junction-box with due regard to salvage of material, was completed in 36 hours.

I believe it is worth mentioning here that most tee connections on similar installations between grade-line pipe, standpipe, and penstock are incorrectly made; that is, the outlet of the tee is usually connected to the grade-line pipe, one run to the standpipe and the other to the penstock. The function of the standpipe, of course, is to relieve the line of sudden surges—great increase of pressure—due to a sudden closure of the gate at the power-house or other causes that check the movement of the column of water. If the run of the tee connect with the standpipe and with the penstock the full force of the grade pipe-line water is thrust against the wall of the tee. If the run of the tee connect the grade-line pipe and standpipe in a straight line the moving water can rush smoothly into the standpipe entrance—finding relief up the pipe—and take the momentum effect from the penstock. This, I believe, is a well-known principle in steam-engineering used in placing air-chambers in pump-lines and it is rather odd that it is so often disregarded in laying water-pipe for power purposes.

Manganese in Spain

*Manganese ores occur in the provinces of Ciudad-Réal, Gerona, Huelva, Murcia, Oviedo, Sevilla, and Teruel. According to official statistics, 837,000 tons of such ores was mined in Spain during the years 1881-1909, nearly all of this coming from the Huelva carbonate deposits, although work on these was almost suspended for the first ten years of that period. The annual production exceeded 100,000 tons during the period 1897-1900, but afterward declined irregularly, averaging only 7229 long tons for 1909-1911, but amounting to 17,120 tons in 1912. As a result of new discoveries and more intensive work during the war period, the yearly output has shown a considerable increase since 1916. Spanish manganese ore is commonly sold on the basis of its percentage content of manganese dioxide. In addition to the production of manganese ore there has been a considerable output in the Cartagena region, province of Murcia, of manganiferous iron ore containing from 10 to 20% of manganese and 20 to 25% of iron, the mineral occurring in association with hematite. It is used only when the content of silica is not in excess of 10%, most of the production going to England.

Province of Huelva. The manganiferous deposits of this province have been described by Hoyer.† They are situated on the northern slopes of the Sierra Morena, being in the form of lenticular masses conformably interbedded among clay-slates and porphyroids, and belonging in part at least to the Culm formation. The length of these masses is sometimes over 3000 ft., but seldom more than 500 ft.; the breadth sometimes exceeds 300 ft., but averaging about 100 ft. For the most part the lenses consist of banded or massive compact rhodochrosite and rhodonite, associated with which are ferruginous silicates and chert. The carbonate and silicate ores are oxidized to pyrolusite and psilomelane for an average depth of about 65 ft. below the surface. The carbonate ores contain from 28 to 45% of manganese, 3 to 7% of iron, and 5 to 15% of silica; the silicate ores contain 39 to 45% of manganese and 20 to 22% of silica. Mining operations started in 1858, but were almost suspended between 1881 and 1891.

Province of Ciudad-Réal. An occurrence of bedded manganese ore in the Miocene rocks of the plateau of La Serena, near Val de Peñas, has been described.‡ The ore consists in greater part of psilomelane, and is stated to contain from 40 to 60% of manganese, 1 to 20% of silica, 0.098 to 0.272% of phosphorus, 3% of oxide of iron and alumina, and 0.14 to 0.37% of cobalt. The deposit, which has an average thickness of about 4 ft., has hitherto been worked only in open-cuts.

Province of Teruel. Deposits of silicate ore, said to contain 33% of manganese and 30 to 37% of silica, were discovered in this province a few years ago, and ore therefrom has been shipped to Belgium and Luxembourg for smelting with aluminous iron-ores.

Province of Oviedo. At Covadonga a group of mines is being exploited by the Asturiana Mines, Ltd. The ores produced are (*a*) manganese ore, (*b*) iron ore, and (*c*) manganiferous iron-ore. The deposits occur as a capping on limestone, the ore being covered to varying depths by an overburden of boulder clay. The ore is won either by open-cast working after the removal of the clay, or by mining, the method depending on the thickness of the overburden. The product is washed, and the resulting minerals are passed over a picking-belt, the manganese ore and the iron ore being separated by hand. The remainder of the mineral, which is too small for hand-picking, is a mixture of pieces of iron ore and manganese ore, and is classed as manganiferous ore. Statistics of production are not available.

*Abstracted from a bulletin recently issued by the Imperial Mineral Resources Bureau.

†'Zeits. f. prakt. Geol.', 1911, 407-432.

‡R. Michael, 'Zeits. f. prakt. Geol.', 1908, 129-130.

BILL FOR REVISION OF THE MINING LAW PRESENTED IN CONGRESS

S. S. Arentz, Representative from Nevada, has introduced a bill providing for revision, amendment, and codification of the mining laws. The bill is practically identical with the draft prepared by a committee of engineers appointed by the Bureau of Mines in 1917 and headed by W. R. Ingalls. The bill consolidates and codifies existing mining laws and embraces amendments conforming to the wishes of the industry. A summary of the draft presented to the House Mines and Mining Committee appeared in the 'Mining and Scientific Press' of June 18.

KENNECOTT COPPER IS PRODUCING 5,000,000 LB. PER MONTH

The Kennecott Copper Co. has curtailed production, but not to the extent that other producers have. The output last month was 4,867,520 lb., making 69,758,760 lb. for the first six months. If the output approximates on the average only 5,000,000 lb. per month throughout the rest of the year, Kennecott should produce 100,000,000 lb. of metal in 1921. Last year's production was 117,017,340 lb. Kennecott can turn out its metal at less than 11c. per pound, a low cost that few big producers can equal, aside from Miami and Cerro de Pasco, and can, therefore, make some profit even with copper under 13c. per pound. Stagnation in the metal market prompted the corporation to omit the usual quarterly distribution of 50c. per share earlier in the year. Dividends are not expected to be resumed until the corporation is able to increase operations and produce funds sufficient for that purpose. Ahead of the 2,787,000 shares of Kennecott outstanding there are $15,000,000 7% bonds which were issued in 1920 to provide additional working capital. This calls for an interest charge of $1,050,000 annually. Kennecott is getting at the annual rate of $1,233,008 from its investment of 616,504 shares of Utah Copper, more than enough to cover the interest on its bonds. Even if Utah decides to again conserve its cash and reduce the 50c. quarterly dividend on its shares at the next meeting, Kennecott ought to earn more than enough this year to pay all charges and interest.

COMPARATIVE FIGURES ON COPPER PRODUCTION

The following statistics appear in the 'Boston News Bureau'. Though not entirely accurate they are interesting in that they are indicative of the present condition of the copper mining industry.

	War maximum		Present operations			
Company	Production, lb.	Employees	Wage	Production, lb.	Employees	Wage
Anaconda	307,000,000	18,000	$5.75	none	2,600	$4.50
Calumet & Arizona	74,898,788	2,347	5.73	none	593	4.91
Chile	102,136,658	5,180	...	*4,000,000	2,396	...
Copper Range	54,747,498	3,287	4.85	*2,000,000	1,260	2.70 to 3.15
Granby	42,809,769	1,350	$5 to $7	*2,500,000	1,350	4.00 to 6.50
Greene-Cananea	62,250,067	4,205	2.35	none	247	3.77
Inspiration	120,772,637	2,068	5.43	none	178	4.75
Miami	58,407,563	1,500	6.15	†45,000,000	1,000	4.50
New Cornelia	46,950,139	1,000	4.94	*1,250,000	300	3.90
North Butte	20,680,000	....	5.75	none	80	4.75
United Verde Ex	63,000,000	937	6.10	none	299	4.50

*Monthly. †Annually.

RULING ON MINE-DEPLETION CALCULATIONS

The Internal Revenue Bureau at Washington has issued the following decision in regard to the re-valuation of mineral deposits: "Held, that the M Company is not entitled to a new valuation for depletion in a known mine; that a discovery cannot be made of any 'probable' or 'prospective' ores which had been or could have been included in the previous valuation, and that the regulations do not recognize a discovery for the purpose of depletion as the result of improved processes of treatment of ores making commercially valuable ores which were theretofore valueless. It is further held that if bodies of zinc ore not theretofore known to exist were discovered within the meaning of the regulations, the fact that the explorations were stimulated by recent improvements in metallurgy which made them commercially valuable for the first time would not bar a claim for discovery, and that if the original valuations of the M Company were based upon estimates of recoverable units, which included only the ores in sight and blocked out, the properties may be re-valued as of the basic date in accordance with the provisions of the present regulations and the depletion rate determined accordingly."

STAR V. FEDERAL LITIGATION MAY BE SETTLED

A compromise of pending differences between the Star and Federal Mining companies, operating in the Coeur d'Alene district of Idaho, for settlement of the damages awarded by a recent decree of the United States Circuit Court of Appeals to the Star company for infringement of its rights, is probable, according to reports. Under the decree of the court, the principles of the Star's claims against the Federal were sustained, and the case remanded to the lower court for determination of the amount of damages. Color is lent to the rumor that a settlement is near by the presence at Wallace of William Wynass, general auditor of the Federal Mining & Smelting Co. Mr. Wynass arrived at Wallace last week, and it is understood that he now has under consideration for checking a proposition for determination of the amount of damages, submitted by the Star people. F. W. Bradley, president of the Bunker Hill company, whose interests are involved in the Star side of the controversy, is also at Wallace. That the Federal will accept

in full the terms proposed by the Star is not believed, but it is thought that by accepting some of them, and leaving other matters still in controversy to the determination of a master in chancery, an end is in sight to the protracted and costly litigation which for several years has involved these two properties.

The Star brought suit in the early part of 1917, alleging trespass on the part of the Federal and removal of ores from Star ground. The case was tried before Federal Judge Dietrich of the United States court, sitting in Wallace, and he handed down a decision in favor of the Federal. The plaintiff company appealed. In May 1920 the higher court reversed Judge Dietrich and sent the case back to him for determination of the amount of damages to be paid by the Federal to the Star.

THE WORK OF THE BUREAU OF MINES IN ALASKA

For the purpose of fostering a more rapid and better development of the mining industry in Alaska, the U. S. Bureau of Mines is re-organizing its work in that Territory. D. A. Lyon, supervisor of stations, and George S. Rice, chief mining engineer, for the Bureau, are now in Alaska on a tour of inspection to determine in what manner the Bureau of Mines can best assist the mining industry. It is proposed to divide the Territory into four districts, each being in direct charge of a Bureau engineer. For the purpose of proper correlation of the work, especially as to keeping its main purpose in view and providing service for particular mining camps which may be isolated or lie on the border between two districts, a supervising mining engineer will be in general charge of the four district-engineers. Owing to lack of funds, one of the district engineers will for the present discharge the duty of supervision. The Bureau of Mines experiment station at Fairbanks will be continued as a headquarters and clearing-house for district-engineers.

District 1 has been assigned to Bert W. Dyer, who will also continue to discharge his duties of Federal Mine Inspector of Alaska. This district embraces the south coast, in the Copper River basin and, for the present, the Katalla oil-fields and south-eastern Alaska.

J. A. Davis will continue to serve as superintendent of the Fairbanks station and, in addition, will be in charge of District 2, which consists of the territory tributary to the Government railroad from Seward to Fairbanks.

District 3 consists of interior Alaska, comprising the Yukon and Tanana basins. This district has been assigned to K. T. Sparks, assistant mining engineer. District 4 is the Seward Peninsula. No assignment of an engineer for this district has been made as yet. It is believed, however, that the best way to assist the mining industry in this district lies in the development of a practical and economical method of cold-water thawing. Charles Janin, consulting engineer for the Bureau, is now compiling and studying the results of experiments made by the various companies, preparatory to investigation by the Bureau.

PRESENT SMELTING OPERATIONS IN MEXICO

According to an official of the American Smelting & Refining Co., who has been making a tour of the plants of that company in Mexico, the smelting situation has improved. He said that five of the six furnaces of the smelter at Chihuahua are now in operation and that the sixth will be blown-in in a few days; one of the ten furnaces of the smelter at Aguas Calientes is in operation; two of the four furnaces of the smelter at Matehuala are in operation and preparations are being made to blow-in the third furnace. None of the furnaces of the company's smelters at Monterrey and Asarco are in operation and it is not known when these plants will be re-opened. This will depend altogether upon the condition of the metal market. The company is obtaining much of the ore for the Matehuala smelter from its Dolores mines. The ore supply for the smelter at Chihuahua comes from the mines at Santa Eulalia and from Parral, the latter being in the form of concentrate. The American Smelting & Refining Co. has entered into a new contract with the National Railways of Mexico for the handling of its freight traffic. It is stated that the practice of operating private freight trains is to be abolished or at least materially modified.

ALABAMA

University.—The School of Mines of the University of Alabama offers five fellowships in mining and metallurgical research in co-operative work with the U. S. Bureau of Mines. The fellowships are open to graduates of universities and engineering schools who have the proper qualifications to undertake research investigation. The value of each fellowship for 1921-1922 is $540 per year of nine months, beginning October 1. Fellowship holders will be required to register as graduate students and to become candidates for the degree of Master of Science in Mining Engineering or Metallurgical Engineering unless an equivalent degree has previously been received. The fellowships have been established primarily for the purpose of undertaking the solution of various problems being studied by the U. S. Bureau of Mines that are of especial importance to the State of Alabama and the Southern States.

ALASKA

Hyder.—The new concentrator at the Premier mine has been started, and is being brought gradually up to capacity. This is the first unit of a larger plant; it has a capacity of 100 tons per day. There is ample feed for it in the way of cullings from rich ore that has been shipped to Tacoma.—— Messrs. McKenzie and McCallum, of Victoria, are establishing three tent camps at different points up the mountain on the M. C. group. Surface ore carries visible gold and silver.

ARIZONA

Katherine.—Development work in the Katherine Extension shaft, placed near the line of the Katherine mine, is progressing under favorable conditions for the early discovery of pay-ore. A station has been cut at a depth of 250 ft., a depth which corresponds closely to the 200-ft. level in the Katherine shaft, and a cross-cut is now being driven to contact with the north-east continuation of the Katherine fissure. The Katherine Extension management plans to drift along the fissure to find the lenses of rich ore.

CALIFORNIA

Bangor.—The old adits and drifts in the Blue Lead and Catskill mines are being cleaned out preparatory to operation by a corporation of which F. F. Ford is president. The land overlying the old channels is said to be suitable for raising citrus and deciduous fruits. A unique plan for combining the business of farming with mining is being tried.

Grass Valley.—Following the agreement reached between the mine operators and the Mine Workers Protective League, whereby a board of arbitration is to settle the wage controversy, operations are rapidly returning to normal. At the Empire mine a full force of miners is at work; it is not the intention to resume work at the Pennsylvania mine for the present. The North Star mine is gradually increasing its production. At the Idaho Maryland the water-level is now reaching the lowest point following a long period of unwatering and repairing. Allan P. Matthew, an attorney of San Francisco, has been selected by the mine operators and W. H. Southcott, Mayor of Grass Valley, has been named by the workers to serve on the board of arbitration. These two will select a third member.——A drift on the 100-ft. level from the new shaft of the South Star mine has broken into the old shaft sunk fifty years ago. According to records,

the old shaft was in good ore, and A. J. Johnson, who is now re-opening the mine, expects to unwater the workings.

Redding.—The Shasta Zinc & Copper Co. has found that the zinc oxide produced at its smelter at Bully Hill is not quite pure enough. So the product is treated in a refining or re-smelting plant. It was hoped that the bag-house would turn out pure zinc oxide. Six hundred tons of zinc oxide is on hand. This is produced at the rate of 30 tons per day. A small refining plant—a pilot plant—has been treating two tons of oxide per day. This finds ready market. A larger plant is under construction—one that will refine the daily smelter product of 30 tons. This new plant will be completed in about two months.

Edmund Jussen of Berkeley has recently taken a bond from F. M. Archer on the old Chicago silver mine near Igo and has set a force of men at work on development. The Chicago was a famous producer before silver was demonetized. Archer in the last few months has found some ore and has opened the mine and made it ready for active development.

Sutter Creek.—A new hoist has been hauled to the Central Eureka mine. Concrete for the foundations is being poured. A 4½-ft. vein of good quartz ore has been found in the south drift on the 3900-ft. level near the line between the Central and South Eureka properties. The Central Eureka has the South Eureka ground under option.——The work of dismantling the surface plant at the old Eureka mine has been completed. Pumps have been pulled and the track removed, and the mine will be allowed to fill with water.

Tuolumne.—The Phoenix Mining Co. has been organized by James Leary and B. A. Whitaker, assisted by Henry Manning and other Oakland capitalists. The Phoenix mine, formerly known as the Empire, situated across the north fork of the Tuolumne river, will be developed. A gas-engine will be used to unwater the 200-ft. shaft, which it is planned to sink another 100 ft. before cross-cutting.

COLORADO

Apex.—Timbering found necessary in the Barrick tunnel has delayed development of the vein recently opened by the Saco De Oro company.——The Evergreen Mines Co. has called the annual stockholders meeting for election of directors, to be held in Denver, August 16.

Breckenridge.—The Vulcan Tunnel Syndicate, recently organized by Denver and Summit county men, plans extension of the Vulcan tunnel on Collier mountain, in the Snake River mining district. The company owns a large acreage of placer and lode claims; ore produced from shallow workings on the lode claims has been shipped. The ore closely sorted assayed $265.70 gold and 40 oz. silver per ton. A vein 20 to 40 ft. wide has been opened in the tunnel, and, excluding the richer stratum, the remaining rock is reported to be of from $7 to $12 grade.

Cripple Creek.—Mineral hill in the western end of the district has a producer in the Engineer's Luck, a fractional claim.——Thompson & Mack, who opened ore on the Ella W., have repeated and are mining ore from a strong vein in the brecciated area that will assay at about one ounce of gold per ton. A 30-ton shipment was sent down to the Golden Cycle mill recently.——A caved stope above the second level of the Damon shaft of the United Gold Mines Co., on Ironclad hill, is producing. Syart Cox and associates, lessees, have installed an electric hoist and are raising and shipping about 50 tons daily that averages about $15 per ton. Samples assay from $8 to $40 per ton.——The Buena Vista workings, Isabella Mines Co., are again active under lease. A shipment was made recently.

Hyder, Alaska. The Port for the Premier Mine in British Columbia

Silverton.—Holdings of the Allerton Mining Co. in the Gladstone district have been acquired by the Golden Consolidated Mines Co.; preliminary work has been completed and development will be untertaken.——Supplies have been sent to the Toltec mine and a large force has been engaged for development.

IDAHO

Coeur d'Alene.—Development has been resumed by the Washington Mining Co. on its property in the Coeur d'Alene. It is surrounded by the Ajax, Ambergris, Happy Day, and C. & R. properties. The lower tunnel, 870 ft. long, is within about 50 ft. of the point vertically under the orebody in the upper tunnel. Operations have been resumed on the Waverly mine, in the Florence district. The property includes a well equipped mill that is ready for operation.

Ore shipments from the Sidney property on Pine creek to the Bunker Hill smelter have been made recently. The ore will average 50 oz. silver and 47% lead. More than 100 tons have been mined since the new organization took over the mine.

The Bunker Hill smelter at Bradley shipped 60,000 oz. of silver to the mint at San Francisco recently. The plant is handling about 100 tons of ore daily in one furnace. Besides the Bunker Hill mines, the Hecla, Caledonia, Sierra

Nevada, and Sidney companies and lessees at the Last Chance and on Big Creek are supplying ore.

Hailey.—The Bunker Hill & Sullivan company has completed the installation of a compressor on its property and is advancing the Crego-Bullion tunnel. This tunnel has a length of 2000 ft. and will be extended 500 to 1000 ft., it is said.——Orebodies of promise are reported to have been found on the Utah-Bellevue and at the south end of the Minnie Moore. The work on the Utah-Bellevue disclosed a body of ore 41 ft. wide, mainly of milling grade. The ore contains silver and lead, and some zinc. The recently discovered orebody on the Minnie Moore is 46 ft. wide and its chief metal content is silver and lead. The scene of the disclosure is a large open-cut made many years ago.

Lenia.—The Idaho Gold & Ruby Mining Co. is nearing a highly interesting stage in its operation. Three giants are pounding on the high banks and 'knocking-down' gravel at the rate of 50,000 cu. yd. per day. This gravel is dropping into the canyon, from which it will be driven into the sluice-boxes as soon as the water of the creek is low enough. An old-fashioned sluice test, made on two and a half yards of gravel, yielded about $2 in gold.

Mackey.—Development has been started by the Mt. Sullivan company at its property in the Alder Creek district. A new adit will be driven to cut the ore at a depth of 525 ft. Samples assaying 20 oz. silver and 30% lead have been obtained in the upper workings.

Talache.—U. B. Hough of Spokane has been placed in charge of construction at the property of the Armstead Mines Co. of Talache. A contract has been let to build a 150-ton mill; also a contract for electric power has been signed and the staff of the mine has been enlarged and reorganized. H. H. Armstead, head of the company and largest stockholder, reports that intensive development work in the mine will be done while the mill is being constructed. The company has 100,000 tons of ore that will average $23 in silver and $2 in gold, besides some lead and copper. It will cost $11 per ton to handle it. The mill will concentrate 150 tons per day into 25 tons of concentrate. Daniel G. McLachlan is mine-superintendent. Power will be secured from the Washington Water Power Co. of Spokane, through the Mountain States Power Co. at Sandpoint.

MICHIGAN

Calumet.—A cargo of 900,000 lb. of copper was taken out by steamer on July 20. Of this amount, 300,000 lb. was Calumet & Hecla metal for export to France, while the remainder of the shipment was copper from the Michigan and Quincy smelters. The export copper completed a 600,000-lb. order, the first 300,000 lb. leaving on July 16. But little inland domestic business is being done.

Houghton.—Both Mohawk and Wolverine have had little difficulty in holding their organizations intact and as a result both are at capacity production. Mohawk is sending 2600 tons of 'rock' to the mill daily, while Wolverine averages 1000. Sinking has been resumed in No. 1 shaft, Mohawk, and No. 4 and 6 also are being deepened. A full program of opening work is under way in all of the operating shafts. Wolverine is still mining the shaft pillars on the 38th, or bottom, level, a work that has been under way for several months. It will take years to exhaust the mine at this rate. None of the old openings is filled with discarded 'rock', which is used as filling in mines that work out the vein entirely as they go, so no obstacles present themselves in removing the pillars. Mohawk is managing to make a new dollar for an old one at the present price of copper, while Wolverine has its costs down to within a cent of the prevailing price.

MISSOURI

Joplin.—Efforts are being made to get the zinc operators of this district to agree on a proposition to shut-down for a period this summer as a means of stimulating the market. Trouble is being experienced in getting a few, who are making profits on their present operations, to agree to the move. Continued operations have resulted in a large supply of ore being piled up at the mines, and operators declare that unless a movement is started to curtail the output they cannot expect to see a betterment of prices for at least another year. The plan as outlined at present is to shut-down immediately and remain closed until the middle of September.

MONTANA

Butte.—The Butte & Superior Co. has commenced drifting on the 2200-ft. level of its Black Rock mine. The objective is the copper-bearing ore-shoot that has been developed on the 2050-ft. level. Recent progress on this level has been encouraging for the development of a good-sized body of copper ore.

Development work is being continued by the North Butte company. From five to six feet of ore on the 3400-ft. level in the Edith May vein is reported. The ore has a copper content of about 9% and the showing is improving in the face of the drift, encouraging the belief that the body of ore in evidence on the upper level will be picked up in the lower workings. Cross-cutting north from the Granite shaft for the Jessie, for the north and south Croesus vein is planned. Raising out of the Spectacular shaft from the 3200-ft. level to the 3000 shortly will be undertaken.

Jens.—It is reported that the Butte & Western Co. is planning to build a mill at its Forest Rose mines.

Race Track.—The main adit of the New Champion mine made connections with the old shaft on July 15 on the 600-ft. level. When the old mine is completely drained, development work will be started, and much of the ore which was opened up 35 years ago will be mined through the new workings. Exploration of the old shaft to the 500-ft. level shows that the mine is in good condition, and it is believed that mining on the 600-ft. level can be carried on without many repairs.

Superior.—New milling machinery is being installed by the Gold Sunset Mining Co. at its property on Cedar creek. The owners are confident that they have solved the problem of treating the ore profitably.

NEVADA

Divide.—Work has been resumed by the Tonopah Divide with a crew of strike-breakers.

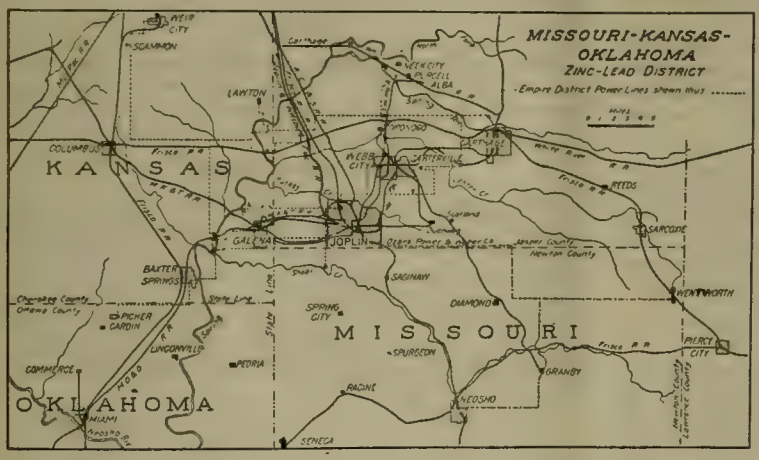
Ely.—E. P. Bowman announces that the Wyoming Mining & Milling Co. will start the company's fifty-ton mill. Ore from the dumps, worth $11 to $14 per ton, will be milled first; the stopes will be opened in the meantime.

Goldfield.—A winze 20 ft. deep in the orebody opened recently in the Silver Pick lease on the Red Top is in a 4-ft. width of $100 ore; ore of this grade is being broken for shipment at a rate of five to six tons daily. The winze is being sunk with a windless and it will only be sent deep enough to give a good idea of the dip and strike of the vein. Two carloads of ore, 90 to 100 tons, will soon be shipped from this orebody, and two more are broken in another orebody below the third level and south of the shaft. The ore south of the shaft assays $18 to $20.——Donald and Giles, Florence lessees, are doing development work. The rich foot-wall seam apparently has flattened under the drift in which their find was made and they are cutting a station in preparation for following it. The seam on the hanging wall is breaking $100 for a width of 3 ft. No further stoping has been done recently. The Cracker Jack continues drifting north from a 35-ft. winze from the 530-ft. level. The Red Hill is driving north-east into the Florence. Woodward has temporarily discontinued work on the 65-ft. level

of the Reilly block and is now working at 110 ft., where he is using an air-drill.

Gold Hill.—Connections between the Belcher and Yellow Jacket mines of the United Comstock company have been made and driving of the transportation tunnel is proceeding from nine headings. Connections have greatly improved ventilation and facilitated more rapid work.——The Comstock Reliance Co. reports development of a vein of shipping ore for 100 ft. The vein ranges from two to three feet wide with gold predominating. Where the lode is intersected by a cross-vein, 12 to 18 in. wide, a winze is being sunk.——The clean-up of the Mexican mill for the first half of July yielded $14,000 in silver-gold bullion. The bullion was extracted from ores coming from the Consolidated Virginia and Ophir properties. Arrangements are being made for enlarged mining operations at both of these properties.

Luning.—Claims have been staked over a wide area near Benton Springs, nine miles north of here, where there is a new gold excitement following a find made on the surface by Francis O'Boyle of Luning, with whom E. C. Watson of



Luning is interested. O'Boyle and Watson have done much trenching and the showing is sufficient to attract mining men from the surrounding region. Among the men holding ground near the original locations are John Houlahan and Harry Moon of Goldfield and James Houghton and Ad Bachman of Luning. The discovery really was made by a badger, who dug from a hole quartz that was found by O'Boyle. The ore is in a wide vein of quartz in andesite and silicified rhyolite. The vein apparently has a width of about 50 ft., and it has been uncovered for a length of 200 feet.

Pioche.—Production will be resumed by the Black Metals company, according to E. H. Snyder, a director of the company. He says that wages have been reduced 25%; that the individual efficiency of the miner has increased 25%; that the cost of fuel-oil has been lowered 40%, boarding-house supplies 35%, and mine-supplies 20% from the maximum of a year ago. Under these conditions the company should make a substantial profit by shipping its silver-bearing ore.

Rand.—The Nevada Rand Mines Co. recently shipped 15½ tons of ore assaying 3 oz. in gold and 80 oz. in silver. Two shipments of ore assaying $115 and $294 per ton, respectively, preceded the last consignment. The high-grade material is being mined from the 180 and 200-ft. level. Lenses of ore assaying $8000 per ton have been found. J. D. Walker is in charge of operations.

Tonopah.—There are working in the mines and mills of Tonopah 645 men, according to official reports, exclusive of those working for the smaller companies. This appears to indicate that the strikers are losing ground rapidly.

UTAH

Alta.—Owing to surface water at the Louise mine there has been a temporary change in development plans, according to R. O. Dobbs, general manager. A body of shipping ore is exposed in the Maggie raise, and as soon as the water recedes, mining will be undertaken. While waiting an opportunity to mine in the Maggie raise, development will be carried on in the 1200-ft. level.——The Columbus-Rexall company has cut in the No. 8 stope the best body of ore yet discovered. It is said that this showing compares favorably with some of the best ore found in the Cardiff mine, adjoining the Columbus-Rexall.

Big Cottonwood Canyon.—Four teams are now employed by the Woodlawn Mining Co. in transporting silver-lead ore from the mine to the railway spur. It is said that after deducting transportation and smelting charges, there is a margin of $19 per ton in the shipments made so far this season. An eight-foot bed of ore was recently opened in what is known as the 'West' drift, which gives average returns of $40 to $50 per ton.

Eureka.—Shipments of ore from this district for the week ending July 16 totaled 129 cars, of which the Tintic Standard shipped 42; Chief Consolidated, 32; Iron King, 12; Eagle & Blue Bell, 12; Victoria, 10; Dragon, 8; Iron Blossom, 6; Swansea, 2; Mammoth, 2; Gold Chain, 1; Eureka Hill, 1. Shipments the previous week totaled 156 cars.

Soon after August 1 the Tintic Mining Co. will be getting a substantial tonnage of mill-ore from the Swansea property, according to Theodore P. Holt, superintendent for the milling company. The shaft has been re-timber to the 500-ft. level, and that level is now being cleared, after a long period of inactivity. The milling company has been receiving ore from the Horn Silver mine at Frisco, Utah, recently.

The directors of the Little May Mining Co. have decided to equip the property with an up-to-date plant, consisting of a compressor, hoist, pumping machinery, and drills, all to be electrically driven. Recent development work at the property has been encouraging. Several streaks of high-grade are have been cut, one of which is two feet in width and averages $1.40 gold, 24 oz. silver, and 14% copper. Five cars of ore have been shipped.

At the Iron King property, 32 men are now employed. The upper levels of the mine are leased to the American Smelting & Refining Co., and the work there is under the direction of Alfred Frank, the well-known mining engineer of Salt Lake City, with B. H. Grant acting as superintendent. The royalty from ore shipped from this part of the property is paying for practically all of the development work carried on by the Iron King company for its own account.

The second quarterly report, for 1921, of E. J. Raddatz, general manager for the Tintic Standard Mining Co., indicates a profit of $4.60 per ton of ore before allowance for taxes and depreciation. The gross value of shipments of 24,566 tons of ore for the quarter was $812,577.02, or $33.07 per ton. Smelter deductions and treatment charges were $14.41 per ton; freight charges, $4.19 per ton; production cost and development, $10.01 per ton. Net earnings for the quarter were $113,179.26, as compared with $54,444.26 for the three months preceding. The report states that the company's new mill, which has been brought to capacity of 100 tons daily, is treating ores with a head of 15 oz. silver, making a recovery of 81.2% of the silver content, or 11.36 oz. per ton. No mill costs are stated. A new six-room brick assay-office and laboratory was erected and

two large new ventilating fans were installed on the 1200- and 1450-ft. levels, and the foundation for the new large air-compressor was completed. The predominating value of the milling ore being silver, the mill was designed and constructed for the purpose of extracting and saving the highest possible percentage of the silver content in the ore. During May and June the silver extraction was 81.2%.

Park City.—Paul Hunt, superintendent of the Park-Utah mine, reports that the water in the Ontario drain-tunnel is gradually receding. Measurements taken the middle of July show that 25.4 second-feet is flowing from the portal of the tunnel. Work in the Park-Utah is handicapped. When the flow is again normal, mining will be resumed.——Sixty men have been employed in grading, excavating, and doing cement work and carpentering for the new mill to be erected by the Silver King Coalition Mines Co. to replace the one destroyed by fire last January. The first carload of steel for the plant arrived on July 15. Development work in the mine is reported as highly satisfactory; the company now has about 300 men on its payroll. The new milling plant will have a capacity of 450 tons per day, and is expected to be in operation late this year.

The output of ore from mines in this district during the week ending July 16 totaled 1475 tons, as compared with 1267 tons for the preceding week. The Silves King Coalition shipped 767 tons; Judge allied companies, 364 tons; and the Ontario, 344 tons.

Stockton.—The shaft being sunk at the property of the Stockton Standard Mining Co. has reached a point 325 ft. below the collar, at which point the cutting of a station has been started, according to C. F. Buehner, president. Sinking will be continued until the 400-ft. level is reached, when drifting will be undertaken to cut two fissures which lie to the east.

WISCONSIN

Cuba City.—The shutting down of the National Separators has been made complete. The acid-works and magnetic zinc-ore separating department are undergoing repairs, and some of the zinc mines shipping to this plant have shut-down temporarily or until the works resume output.——The unsatisfactory conditions of the zinc-ore market has been responsible for the accumulation of 4000 tons of 60% blende at the National Separators; 3000 tons at the New Diggings separators of the Wisconsin Zinc Co., and 1000 tons at the Enterprise separators at Platteville owned by the Block-House Mining Co.——Crude-zinc concentrate is held in large quantities by the Frontier Mining Co., of Benton, 7500 tons; Rodhams Mining Co., 4000; Zinc Hill Mining Co., 1500; Connecting Link Mining Co., 2000; and Block House Mining Co., 1000.

Mineral Point.—Reduction in the price of zinc oxide, announced by the New Jersey Zinc Co., amounting from ¾c. to 1¼c. has resulted in stimulating business at the Mineral Point Zinc Works, where from 50,000 to 100,000 tons of zinc oxide is manufactured annually. A single shipment amounted to 20 cars. The freer movement of this stock has encouraged a better feeling in mining circles, since it is apparent that there is more likelihood now of increased operations than a shut-down of the works.

Platteville.—The Zinc Roofing & Products Co., recently organized and incorporated, has established headquarters here. Branches will be established at various points as rapidly as the volume of business warrants. The Illinois Zinc Co. is now making a zinc shingle, which is meeting with favor. Corrugated zinc for roofing is coming into demand. The promoters claim that there is a ready outlet for 100,000 tons of slab zinc annually in products manufactured for building purposes, and that the greatest necessity now to restore the zinc industry is a proper publicity campaign.

WASHINGTON

Valley.—Assays made by Arthur L. Hooper, president of the Admiral Consolidated Mining Co., from an ore-shoot opened recently in the north end of this property, returned $30 per ton in copper and gold. This demonstrates another source of ore to justify the erection of a concentrator which the company plans to build. The shoot is 4½ ft. wide and in it is a 14-in. streak of carbonate from which the assay was made.

Leadpoint.—Development of lead-silver properties is planned by the Red Top Mountain Mining & Milling Co., incorporated recently with a capitalization of $100,000.

Northport.—The Blue Ridge Mining Co., whose mines are 14 miles south-east of here, uncovered ore containing silver, lead, and some zinc, at different places for a distance of 1200 ft. along the vein. A tunnel has been driven which cross-cuts the lode at 60 ft.; here the orebody is five feet in width. Assays of shipping ore run 40% lead and 20 oz. silver. Some milling ore also is blocked-out. Thomas Taylor is president of the company.

BOLIVIA

La Paz.—W. Duval Brown, American consul, is authority for the statement that American interests have acquired tin-bearing lands valued at $2,000,000. The present ouput is not large but it is epxected that it will be increased.

BRITISH COLUMBIA

Alice Arm.—The staff of the Taylor Mining Co. has arrived here for the purpose of re-opening the railway and Dolly Varden mine at once. There is some 3000 tons of ore on the dump that could not be transported to Anyox last year, and this will be shipped as soon as the necessary repairs have been made and the railway is in running order.——The Provincial government is constructing trails in the Illiance River and Upper Kitsault River districts, to open up the country for prospecting.

Greenwood.—It is reported that C. A. Banks is about to re-open the Jewel mine. Banks operated this mine for a considerable time until the rising cost of labor and supplies made it unprofitable. Now that costs have dropped markedly it is thought the mine may be worked profitably again.——An important find has been made in a winze at the Tam O'Shanter mine, at Deadwood camp. The ore shows free gold and silver; a sample assayed $13.20 in gold and 202 oz. in silver per ton. The property is owned by A. J. Morrison and Dan McGillis.

Nelson.—Justice Murphy has handed down his decision in the case of Insinger v. Cunningham in connection with the Hewitt mine, at Silverton, which Clarence Cunningham operated under lease and bond from Robert Insinger and associates. Insinger is granted the value of the development work that Cunningham undertook, but failed, to do. The plaintiff cannot recover the payment that Cunningham withheld, nor can he recover damages for not being given possession of the mine, but he is entitled to an accounting of the amount of ore mined and shipped. The counter claim for damages on account of not being permitted to operate the property is dismissed.——A narrow vein, assaying $23.60 in gold, 52 oz. in silver, and 44% in lead has been uncovered in a 45-ft. raise at Silver Reef group, on Anderson creek, about a mile from here. The property is owned by W. J. Richards, W. R. Symonds, and R. Barron, who drove a tunnel 225 ft. and put up the raise entirely themselves during last winter and this spring.——The Van Roi mill, at Silverton, has been re-started.

Trail.—At the annual general meeting of the Le Roi No. 2 mine, held in London on June 23, it was decided to add a Minerals Separation plant to the equipment at the mine.

There is a dump of ore at the mine which is too low grade to ship but from which D. Lay, the manager, estimated $55,000 can be obtained in the form of concentrate.

ONTARIO

Cobalt.—Mining enterprises in Northern Ontario are benefiting greatly from the adverse rate of exchange as between Canada and the United States. American money is at a premium of 14% in Canada, and this is adding at the rate of more than $250,000 monthly to the revenue received for the gold and silver produced in Ontario. This amounts to over 40% of the wages paid by the mines.——The price of supplies at Canadian mines is declining rapidly. Machinery, lumber, chemicals, etc., are included in the downward swing in prices. Electrical equipment has declined 25% in many instances, while 40% blasting-powder is now quoted at $17 per hundred pounds, as compared with $22 in December last. During June the Nipissing mine produced $162,824, made up of $137,264 in silver and $25,560 in cobalt. The low-grade plant treated 6580 tons and the high-grade plant treated 174 tons of ore.——During the first half of 1921, the Bailey Silver Mines realized $68,936.77 in gross revenue. The Bailey mine itself shipped 6451 tons of ore during the six months. The company's custom mill treated 4150 tons of ore in June, of which 1060 tons came from the Bailey mine.

Ore has been found at the 9th level of the Kerr Lake mine. Silver occurs in a number of stringers which measure less than one inch in width, the silver content being about 300 oz. per ton. One car containing 45,184 lb. has just been shipped, in which the silver content is 350 oz. per ton.

Porcupine.—There are approximately 2500 men engaged in the operating mines and on assessment work in the Porcupine district. The annual payroll amounts to close to $4,000,000. Of this total, the Hollinger, Dome, and McIntyre mines employ an aggregate of over 2000 men. In the Kirkland Lake district there are over 500 men engaged at the operating mines, while on small prospects and engaged in doing assessment work the Kirkland Lake total may reach about 800 men. This indicates a payroll of over $1,000,000. It is clear that the gold-mining industry of Porcupine and Kirkland Lake combined in paying out wages at the rate of about $5,000,000 per year. Wages are generally high, the present scale being the highest point reached, and with no reduction having so far been made. This is believed to be due to the fact that the advance in wages at the gold mines was slower than in many other industries, and has led to a reduction being deferred.

MEXICO

Calabacillas.—A. H. P. Wynne reports the sale of the San Geronimo mines, owned by the Sierra Mining Co., to American capitalists of Lawrence, Kansas. They intend to begin operations immediately. The properties, which were producers of high-grade ore, will be re-opened by means of a new cross-cut from the present mill, about 300 ft., to strike the Poro workings. Thence it is planned to drift along the contact to intercept the main San Geronimo workings at the 7th level. In running this drift, which will be some 1200 ft. in length, virgin ground will be explored. The plan of J. R. Greenless, president of the new company, is to install a modern mill of capacity to handle 70 tons of ore per 24 hours. Mr. Wynne has been retained by the new operators to supervise the development work.

Mocorito.—The Palmarito mine, a large silver property that has been operating continuously throughout the revolutionary periods, is mined by the glory-hole system. Stamps crush the ore to the necessary fineness, after which it is treated without concentration by cyanide. Plans are now under way to increase the mill capacity in the near future. This property is controlled by capitalists of Philadelphia.

Saltillo.—The American Smelting & Refining Co. has acquired possession of the Argentina group of metal mines in the Potrerillos mountains in the municipality of Castanos. The property was recently denounced; the survey includes the Esmeralda mines which were allowed to go by default for non-payment of taxes during the revolution. It produces silver, copper, and zinc. At the start, development work will be done in order to put the mines in shape for production.——The Tres Estados Mining Co. held a board of directors meeting here recently and levied an assessment of 50 centavos per share for the purpose of carrying on the work at its mines in Coahuila.

Zacatecas.—La Luz Mining Co., of San Luis Potosi has

Utah

called for a general meeting of shareholders to take place next August. One of the important matters to be placed before the stockholders will be the discussion and acceptance or rejection of the proposition made by the Cia. Exploradora de Minas de Mexico to take over the mines belonging to La Luz company that are situated in the San Luis Potosi district.——E. Palmer has recently added a number of new properties to his mining interests in the State of Zacatecas by filing on a new group in the Parroquia mountains near here.——Miguel Flores has taken over the Santa Tomas mines in the Sombrerete district and is preparing to sink the old main shaft to a greater depth and extend the other workings.——Several new filings have been made recently on promising prospects in the Mazapil copper district in the mining district of El Oro by native miners. The most promising of these new denouncements are the Buena Suerte and El Porvenir groups.——Some rich cinnabar ore has been discovered near San Miguel by Emilio M. Gaya, a Spanish mining man. The properties are near the old Ascension and Maravillas mines which have produced considerable quicksilver, aside from other valuable metals.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Kirby Thomas is at Toronto.

F. W. Bradley is at Kellogg, Idaho.

Albert Burch is on his way to Philadelphia.

Harold Boyd is in Ecuador for a few months.

Charles Brackin is in the East for the summer.

A. W. Harris is returning from Burma to New York.

Charles Butters has returned to Oakland from Nicaragua.

Nelson Dickerman has returned from Korea and is now in New York.

Donald D. Smythe is with the Cerro de Pasco Copper Corporation in Peru.

W. L. Penick, sales manager for the Hardinge Company, is in San Francisco.

Walter X. Osborn is with the Rowley Copper Mines Co., at Gila Bend, Arizona.

Louis A. Wright is spending a couple of months in Spain on professional business.

Oscar Lachmund, of Spokane, spent several days in Utah recently on professional work.

C. B. Lakenan has returned to McGill from a trip to Alaska and British Columbia.

Charles F. Rand has been elected to honorary membership in the Iron & Steel Institute, London.

W. Allen Howard, manager of the United States smelter at Midvale, Utah, has been in Nevada recently.

E. R. Ramsey, Western manager of the equipment sales department for the Dorr Company, is in San Francisco.

M. N. Colman, recently at Merced, is now with the California-Rand Silver company, at Randsburg, California.

H. R. Bischoff, who has been with the Crown Reserve mine, at Cobalt, Ontario, has moved to St. Paul, Minnesota.

C. N. Schuette has been appointed manager of the Rosebud mine of the Silver Gulch Mining Co., at Dunton, Colorado.

Percy E. Barbour, assistant secretary of the Institute, is receiving congratulations on his recovery from a serious illness.

H. Kenyon Burch, who recently underwent an operation at the Copper Queen hospital at Bisbee, Arizona, is reported to be improving.

Paul Hunt, superintendent for the Park-Utah Mining Co., has returned to Park City after a vacation spent at Redlands, California.

Waldemar F. Dietrich, Associate Professor of Mining in Stanford University, is in Utah, visiting mining and metallurgical districts.

Frank Daniels passed through San Francisco last week on his return to Pasadena, after a month spent in northern California on examination work.

Oliver C. Ralston, of the U. S. Bureau of Mines, has been transferred from the University of Washington, at Seattle, to the University of California, at Berkeley.

H. L. Sulman has been awarded the gold medal of the Consolidated Gold Fields of South Africa at the hands of the Institution of Mining & Metallurgy, London.

L. D. T. Geery, superintendent of the electrolytic department of the Chile Exploration Co., at Chuquicamata, spent a few days at the plant of the New Cornelia Copper Co. at Ajo, Arizona.

Frederick H. Morley, of San Francisco, a member of the editorial staff of the 'M. & S. P.' in 1913, was seriously injured by a fall while mountaineering near the Yosemite Valley on July 23.

H. C. Carlisle passed through San Francisco last week on his return from South America, where he spent several months on examinations for the Nevada Wonder Mining Co. His address will be Tonopah, Nevada.

Welton J. Crook has resigned as chief metallurgist to the Pacific Coast Steel Co., to accept an appointment as Associate Professor of Metallurgy in Stanford University. He remains consulting metallurgist to the steel company.

Obituary

John H. Miles, who died at sea aboard the S. S. 'Victoria' on June 30, on his way home at Oroville, in California, from Alaska, was prominent in the history of gold dredging in California, Idaho, and Montana. He is credited with being the first to employ cold water for thawing the frozen gold-bearing gravel of Alaska; for this process he was granted a patent by the U. S. Patent Office and by the Canadian government. He is survived by his wife and one son, Malcolm, both of Oroville.

Edward Dickenson Bullard, senior partner of the firm of E. D. Bullard, died suddenly on July 15, 1921. He was born in Massachusetts in 1854 but was a resident of San Francisco for 25 years prior to his death. His firm was a pioneer dealer on the Pacific Coast in carbide and acetylene gas, and later extended its activities to the supplying of all sorts of apparatus for mine and industrial lighting and safety equipment. He enjoyed excellent health up to the evening of his death, which occurred while he was driving home in his automobile from an entertainment that he had attended with Mrs. Bullard. He is survived by his wife, two sons, and a daughter. In his death San Francisco has lost a respected and useful citizen.

P. J. Kelly, shift-boss at the Highland Boy mine of the Utah Consolidated Mining Co., at Bingham, Utah, and **Anton Oleson**, a miner, were killed on July 18 on the 1300-ft. level of the mine, where they were caught and crushed by the cage in a manner not definitely determined. Kelly's head was crushed and he is believed to have died instantly, while Oleson was so badly injured internally that he died within a few minutes. No one witnessed the accident. Kelly was 45 years of age and had been with the company for 14 years. He is survived by his widow and two children. Oleson was 26 years of age and unmarried. He fought in the world war and was severely wounded at Chateau Thierry, lying on that battlefield 36 hours before being rescued.

Albert Taylor, manager in the North Atlantic district for the Electric Storage Battery Co., died suddenly on July 6 in New York. He was taken ill in his office and died a few hours later in the hospital. He was born in Liverpool, England, in 1864. In 1884 he was graduated from Princeton university. He served an apprenticeship with the Edison General Electric Co. and in 1885 joined the United States Electric Co. This company was absorbed by the Westinghouse company in 1889 and in the spring of 1890 he became associated with the Stanley Electric Manufacturing Co., remaining in its employ for a period of eight years. In 1898 he entered the employ of the Electric Storage Battery Co. as a salesman. In 1900 he was made assistant manager and in March of the same year was appointed manager of the New York office. When, in February 1920, the growing business of the company made it necessary to divide its territory into five districts, he was selected as manager of the North Atlantic district. His character won him many friends. His ability to put himself in the position of the other man won for him a merited reputation for square dealing. He enjoyed the utmost confidence of all his customers.

THE METAL MARKET

METAL PRICES

San Francisco, July 26

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.50
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$70
Platinum, 10% iridium, per ounce	$88
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

July 25.—Copper is more active but lower. Lead is inactive but firm. Zinc is stagnant but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	New York cents	London pence
July 19	59.50	37.37	June 13	58.39	35.20
" 20	59.37	37.00	" 20	58.77	35 18
" 21	60.12	38.00	" 27	58.69	35.25
" 22	60.37	38.00	July 4	58.90	35.33
" 23	60.25	38.00	" 11	58.69	36.75
" 24 Sunday			" 18	60.25	37.56
" 25	61.25	38.75	" 25	60.14	37.85

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	....
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59 33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
July 19	12.62	June 13	12.91
" 20	12.62	" 20	12.85
" 21	12.50	" 27	12.68
" 22	12.37	July 4	12.62
" 23	12.25	" 11	12.62
" 24 Sunday		" 18	12.62
" 25	12.25	" 25	12.43

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	....
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
July 19	4.40	June 13	4.75
" 20	4.40	" 20	4.47
" 21	4.40	" 27	4.32
" 22	4.40	July 4	4.43
" 23	4.40	" 11	4.43
" 24 Sunday		" 18	4.40
" 25	4.40	" 25	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5 53	8 63	....
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	....
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
July 19	4.75	June 13	4.98
" 20	4.75	" 20	4.95
" 21	4.70	" 27	4.88
" 22	4.70	July 4	4.75
" 23	4.70	" 11	4.77
" 24 Sunday		" 18	4.76
" 25	4.70	" 25	4.72

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	....
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
June 28	48.00	July 12	48.00
July 5	48.00	" 19	47.50
		" 26	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	80.00	50.00	July	100.00	88.00	....
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

MONEY AND MARKETS

The United States is practically through the period of violent business disturbance which began in May 1920. We will from time to time have visible evidences of the distressing conditions through which the country has been passing, but these occurrences should be regarded not as indices to forward conditions but as relating to the past. The changes which have taken place have not as yet been recognized by the business public for two main reasons. The period of normal midsummer dullness now at hand has obscured the certain evidences of improvement and there has been lacking a thorough comprehension of credit conditions, says the market letter of the National Bank of Commerce of New York.

Failure to recognize the passing of the period of insufficient credit has resulted from lack of recognition of the fact that for a long time the credit shortage has been apparent rather than real and due in large part to the unsatisfactory character of some of the risks offered. There is now no bank credit available for operations designed to hold prices at fictitious levels. Orderly organized marketing, if fair, succeeds, but attempts to hold prices above the levels determined by international supply and demand are certain eventually to fail. American business and government alike have thus far kept clear of entanglements of this character, but even so, American business cannot avoid their indirect effects. Valorization schemes providing for indefinite holding for arbitrary prices of such commodities as wool, silk, coffee, sisal, and sugar, would involve the purchase by American consumers of raw materials at levels likely to involve ultimate loss, and as long as these plans contemplate the maintenance of an artificial price they cannot be disregarded in view of credit risks.

Some businesses have found difficulty in getting what they have felt to be a fair line of credit. This has been because of a desire to operate on a basis of inventories of raw materials and goods not yet written down or because in these instances heavy investments have been made in plant and equipment at inflated prices. In such cases they are not yet willing to admit that they will have to take their losses and adjust their operations to make profits on real values only.

Although occasional failure to secure desired credit accommodations has served to keep alive the impression that there is a shortage of bank credit, the truth is that there is now available a volume of credit larger than present business requires. The main requisite for a return toward normal conditions is the will to try for business on a level where it can be had. The period of general liquidation of the raw material markets of the United States has passed. Recent declines are due to conditions of supply and demand in specific lines. This is a normal condition. Wholesale prices of many classes of manufactures have been fully deflated. This is not true in all lines, but recent cuts in the price of steel and widespread reductions in wages indicate that adjustment in wholesale prices will not be long delayed. Retail prices show wide irregularities, and high-cost stocks have been largely disposed of. Price stabilization is, therefore, not far ahead.

Steady betterment of the banking position which has been in progress during the current year gives full assurance against credit stringency when crop-financing requirements become effective.

MONEY AND EXCHANGE

Foreign quotations on July 26 are as follows:

Sterling, dollars:	Cable	3.58
	Demand	3.59
Francs, cents:	Cable	7.80
	Demand	7.82
Lire, cents:	Demand	4.38
Marks, cents		1.32

Eastern Metal Market

New York, July 20.

All of the non-ferrous metal markets are extremely quiet.

Copper is quiet and there is some weakness in prices in the outside market, though leading producers are holding for 13 cents.

Tin is lower in price because of freer offerings, both here and in London, and also on account of the British exchange situation.

Lead is quiet and prices are unchanged.

Zinc prices are easier; there is little demand.

IRON AND STEEL

Cutting of the steel prices announced early in July has been more general in the past week, particularly in plates, structural shapes, reinforcing bars, and sheets. According to 'The Iron Age' the favorable feature has been that more business has arisen. In the eagerness of producers to get a share, prices suffered.

Railroad and construction demand are responsible for most of the week's activity in plates and shapes and the accompanying concessions of $3 to $5 per ton in the prices of the two products.

Steel-works operations are on a smaller scale in some districts and in other practically unchanged. The Youngstown district, in particular, is at a low rate.

Aggressive competition between Steel Corporation and independents has been seen in the Chicago market. Pittsburgh basing has gone by the board in that district, and, on a small plate-order from a railroad, 1.80c., Chicago, was done. Presumably lower prices were made on 3000 tons of steel for car-repairs, 2600 tons placed by one fabricating company and 1200 tons by another. The week's transactions in Chicago show that the extent to which the announced prices are cut depends entirely on the size and character of the order and the hunger of the mill.

At Philadelphia a 5000-ton order for plates and shapes for a fabricating company went at 1.75c. for plates and 1.80c. for shapes, whereas both are presumably 2c., Pittsburgh. Several lots of about 1000 tons, reported in the New York market, brought out prices of 1.80c. and 1.85c., and in one case 1.70c.

In concrete-reinforcing bars 1.70c. has been reported for soft steel. A good volume of such bars is under active negotiation, including 3800 tons for export.

Considerably more car-repair work is ahead. The Lehigh Valley's repair and rebuilding program includes 5000 freight-cars and the New York Central will do much both in car and locomotive repair. The Illinois Central is expected to buy 140 locomotives.

Sheets have been sold in the past week at $3 to $5 per ton below the so-called stabilized basis. Buying is better and mill operations have increased about 10%.

Eastern Pennsylvanian furnaces have taken the lead in reducing pig-iron prices, reductions of from $3.50 to $4 per ton having been made in the past 10 days, the most precipitate drop since the decline began. This has been largely due to keen competition from Buffalo, where very low quotations prevail. In other centres, new concessions of from 50c. to $1 have been made.

The high duties on manganese ore and ferro-manganese duties in the new tariff bill, having passed the House against the protests of steel producers, a determined effort will now be made by the industry to secure reduction by the Senate.

COPPER

Weakness in copper prices in the outside market was slightly more pronounced during the past week. Leading producers continue to quote 13c., and apparently are adhering quite firmly to that figure, but the smaller producers at a shade under this price are taking most of the current business, which is small in volume. There are no new features, the whole market being in a decided slump.

TIN

Further weakness in tin prices has been noted during the past week, there being two contributing factors, namely, increased offerings of the metal both here and at London, and the British exchange situation. A small amount of business was done on Tuesday of last week for forward shipment at 28.25c., but during the remainder of the week practically nothing was done. On Monday of this week there was a little more selling for forward delivery at 27.25c. On Tuesday the market was quotable at 27 cents.

LEAD

The American Smelting & Refining Co. is still making the lowest price on lead, 4.40c., New York, and is taking most of the very limited amount of business that is being placed. Some of the other sellers are quoting 4.45 to 4.50c. The outside market has slightly weakened, however.

ZINC

Prices on zinc are lower. Leading producers quote 4.25c., St. Louis, or 4.75c., New York, for July, with an advance of five points for August and another five points for September. On July shipments, however, 4.25c., St. Louis, is being shaded by some of the smaller producers. A slightly better demand for high-grade zinc is reported. Very little business is being placed.

ANTIMONY

Carloads for July shipment are now freely offered at 4.65c., New York, duty paid.

ALUMINUM

The Aluminum Co. of America has reduced its prices, the new quotations being as follows: 99% ingot virgin aluminum, 25c.; 98-99%, 24.50c.; No. 12, 23.80c., and sheets, 39.10c., all f.o.b. shipping point. These prices are still from 2 to 2½c. above the prices on imported aluminum.

ORES

Tungsten Ore: The quotations on tungsten ore are nominally $3 to $3.25, but some sellers are asking considerably higher prices.

Ferro-tungsten is available at 42 to 43c. per pound of contained tungsten.

Molybdenum Ore: This ore is quoted at 50 to 60c. per pound of contained sulphide in regular concentrates, usually 85% MoS_2.

Manganese Ore: There is no demand, but manganese ore is held nominally at 22c. per unit.

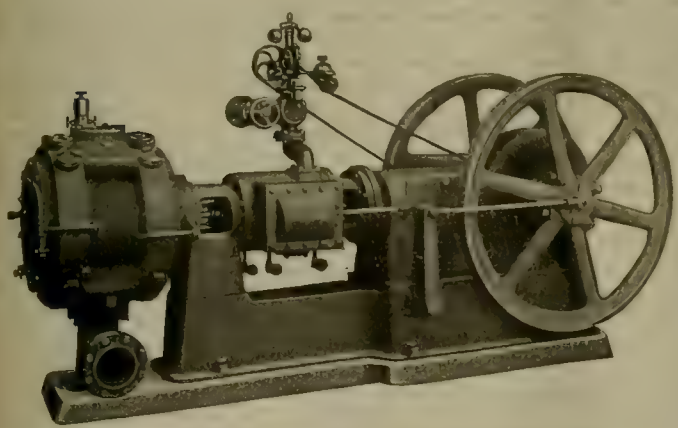
The total production of portland cement in the United States during the six months ending June 30, 1921, represents about 94% of the quantity made in the corresponding period of 1920 and over 42% of the total production in 1920; the shipments are about 98% of those of the first half of 1920, and nearly 42% of those for the whole year 1920. The stocks, which amounted to more than 11,000,000 bbl., are slightly above normal, comparing with approximately 9,000,000 bbl. on June 30, 1920, and 8,941,046 bbl. on December 31, 1920.

INFORMATION FURNISHED BY MANUFACTURERS

SULLIVAN DRY-VACUUM PUMPS

The accompanying illustration shows a Sullivan "WA-61" steam-driven, single-acting, dry-vacuum pump. These machines are built in capacities ranging from 300- to 1600-cu. ft. displacement per minute. The intending purchaser of a vacuum pump within these limits will find that the Sullivan machines embody numerous features of design and construction which secure economy of power, continuous operation, and high efficiency.

One of the leading features of this class of pumps, which makes for efficient operation, is the use of the Sullivan improved wafer-plate valves. These wafer valves are compact, low in lift, and very light in weight. They are practically indestructible, and require no regrinding or other attention. They are noiseless in operation and are so light



Sullivan Dry-Vacuum Pump With Single Steam- and Vacuum-Cylinders

that they will function under the exceedingly small pressures developed in vacuum service, enabling these pumps to create and maintain an unusually high degree of vacuum (within one-half inch of the barometer reading on a closed suction).

These pumps are adapted for any dry-vacuum service within their capacity range. They are substantially built, and the amount of metal and area of bearing surfaces which will be found in the principl working parts, such as crank-pins, shaft, connecting-rods, etc., are unusually liberal and insure stable dependable, operation. All working parts are fully enclosed and are splash lubricated, so that wear and repair are reduced to a minimum.

Sullivan vacuum pumps are built upon the interchangeable part system, thus securing the advantages of production in quantities. As is the case with Sullivan air-compressors, including the simplest as well as those intended for the highest duty, the materials for these pumps are carefully selected for their respective purposes; accurate painstaking workmanship, rigid inspection, and thoroughgoing tests both during manufacture and after completion are guarantees of satisfactory and long service in the customer's engine room.

The equipment for the "WG-61" vacuum pump includes: one sight-feed lubricator for the vacuum cylinder; one complete set of drain cocks; one set of wrenches for removal or adjustment of the various parts of the machine; one set of packing for the piston rod; foundation blueprint and instructions. In addition to its line of single-acting steam, the company manufactures belt-driven pumps and duplex pumps of larger capacity but of this same class.

NEW COMBINATION BALL-MILL FEEDER

The Hardinge Company has recently designed a combination drum- and scoop-type feeder for ball- and tube-mills. The largest size has a capacity-rating of 2000 tons of dry ore per 24 hours. This will enable the feeder to take a large initial feed in addition to a large circulating load. The drum of the larger feeder is 48 in. diam. and allowance is provided for a scoop with a radius of 48 to 54 in., as may be required by the customer. Aside from its large capacity all parts of the feeder are reversible. This means that the purchaser no longer has to specify which way his mill is rotating when buying a feeder. It also enables him to reduce his stock when he has mills operating in both directions, as by merely changing the parts the same feeder can be used on a mill rotating in clockwise or counter-clockwise direction. Parts are made replaceable to take care of ordinary wear and as a consequence, the cost of renewing parts is small. The advantages of a combination feeder are, in general, well known, but for those who have not used them, a word as to their operation will be of interest.

The initial feed is fed by a chute to the opening in the drum, this initial feed being coarse material, which, if dropped into a box and picked up by a scoop, causes undue wear on the scoop-lip and sometimes, when extra large pieces drop in the box, might break the box or the feeder itself. The over-size is returned from the classifier at a lower level; accordingly means must be provided to lift it up and into the drum. This is taken care of by a scoop on the outside of the drum which operates in the ordinary feed-box but has no large material to handle, as none is dropped into this box and therefore the wear is greatly reduced and there is no danger of breakage to the box. Such feeders as this have been used for a number of years on the large mills handling in excess of 500 tons per 24 hours and have proved to be practical, as the wear is light and they cause no mechanical trouble.

A NEW FLOTATION REAGENT

In all the writings on the flotation of ores it has always been the contention of the writers that a colloidal element could never be used in the flotation of minerals, or as a substitute for oil, and that any colloid was fatal to flotation. Royer Luckenbach, of Brooklyn, N. Y., the inventor of this reagent, claims to have proved by commercial tests that their contentions are entirely erroneous.

In the oil-flotation process, as is well-known, the oil has

to be beaten into the pulp, by violent agitation, in mixers before it is in a minutely sub-divided condition to reach the particles of mineral in the pulp; whereas, in this new process, the great advantage of using an easily emulsifiable element, that instantly breaks up in the body of the pulp into a minute colloidal sub-division, and instantly attaches itself to every particle of mineral without any pre-mixing is a radical improvement, both as a time element and greater thoroughness in operation, producing an extremely clean high-grade concentrate in the first cell, together with a high recovery. Extractions on difficult ores have been made by the Rex reagent as high as 98.9% with a 48% concentrate.

This reagent [which is a pine-pitch in alkaline solution] forms a very close-grained viscous froth of great volume and power, being a frother and selector combined; whereas, in oils the good frothers are poor selectors and good selectors are poor frothers, necessitating the use of a good frothing-oil with a good selector, the usual combination being coal-tar and creosote as selectors, with pine-oil as a frother, which latter has so greatly increased in price as to be almost prohibitive.

The Rex reagent is inexpensive, and its economical use is still further reduced by the re-use of the pulp-water, which retains its powerful frothing and selecting qualities to a marked degree for numerous re-uses of it with but a little addition of the original reagent, as needed.

The reagent can be used either in an alkaline, acid, or neutral circuit. The process is entirely chemical and is at all times under perfect control of the operator, whereas, the oil process is entirely mechanical. This chemical control permits of preferential flotation, as the separation of zinc from lead, pyrite and pyrrhotite from chalcopyrite, and numerous combinations can be made with it and other chemicals to meet the conditions in ores. It will extract copper carbonate without sulphidizing—also lead carbonate and all sulphides, including metallic copper and silver, and is particularly good on gold sulphides, producing an extremely clean concentrate in the first cell, that can be cyanided if desired, which by oil it is impossible to do, as the oil interferes with the solvent action of the cyanide.

The cost will average eight cents per ton. No changes are necessary in any mill now using oil to replace it with this reagent, which is practically a universal reagent, and is adaptable for use on all ores with but little change, and, being a powerful selector and frother, all in one, its value in that respect will be greatly appreciated in the flotation of ores. The mining industry will welcome its valuable feature of iron elimination in ores, which oil has failed to overcome, as it sweeps away the only serious obstacle to the full development of many valuable but low-grade mines, long neglected in both the precious and baser minerals in this and other countries.

As an instance of what has been done, the Canadian government at Ottawa made exhaustive tests on a full commercial scale in 1920 on ores high in iron pyrite and pyrrhotite containing 3% chalcopyrite; an extraction was made of 94% with complete elimination of the iron. Demonstrations of this process are given at the Luckenbach laboratories, at 105 Liberty St., Brooklyn, New York.

COMMERCIAL PARAGRAPHS

Offices have been opened at 236 Mills building, San Francisco, by the **Mine & Smelter Supply Co.** M. H. Carpenter is the representative in charge.

It is announced that the **Dominion Oxygen Co., Ltd.**, will break ground for a new quarter-of-a-million-dollar oxygen plant at Montreal, which will double the company's present capacity. The building will be 100 by 100 ft., and will be substantially a duplicate of the company's Toronto plant.

The San Francisco office of the **Pawling & Harnischfeger Co.**, of Milwaukee, has been moved from the Monadnock building to 32 Beale street. At this new address the company maintains a complete service-station, warehouse, and display room for cranes and hoists, machine tools, and excavating machinery. R. M. Taylor, district manager for the Pacific Coast, has his headquarters now at the Beale street address. J. MacFerran Taylor is a new member of the Pacific Coast sales district.

E. W. Bullard, junior partner of the firm of **E. D. Bullard**, San Francisco, has accepted the invitation of the U. S. Bureau of Mines to be one of the judges at the International First-Aid and Mine-Rescue Contest to be held September 1, 2, and 3 at St. Louis. Mr. Bullard will leave San Francisco the early part of August for the East, where he will spend a month visiting the large mines and metallurgical plants to study their safety and welfare work.

A catalogue presenting its full line of packings, gaskets, and pump-valves is one of the important recent publications of the **United States Rubber Co.** Fully illustrated, it departs from the usual form of such catalogues and is filled with definite information regarding each item listed and the specific uses for which it is best fitted. To assist in the selection of 'the right packing for the right place', a classified index of the various styles of packing sets forth the packings which are recommended for the different conditions of service. The drawings show the details of construction with such clearness that the adaptability of any style of packing may easily be judged.

The Du Pont Company has developed and perfected a formula for the manufacture of a straight dynamite that is proof against freezing even in zero temperatures. As a consequence of this development, the company has determined to discontinue the manufacture of its former straight dynamite and hereafter all this kind of explosive will be 'low-freezing'. The perfection of the formula is the result of years of experimentation in the laboratory and in the field and marks one of the greatest advances in the art of explosives manufacture. Straight dynamite has for years been the standard of the world in nearly every kind of open work, but a disadvantage has been its liability to freeze at temperatures below 50°F. As any dynamite loses some of its efficiency when chilled or frozen, many attempts have been made to make it low-freezing. The perfection of the new formula by the Du Pont Company makes it possible to use straight dynamite the year round in industrial operations. Thawing, with its loss of time and attendant dangers, has practically been eliminated.

To meet the severe requirements found in steel-mills for driving mill-tables, screw-downs, tilting tables, and other machinery, a line of unusually rugged direct-current mill-type motors has been developed by the **General Electric Co.** A complete description of these motors is given in Bulletin No. 48121.1A, entitled 'Direct Current Mill Type Motors, Type MD and MDS'. Some of their chief characteristics are listed in the bulletin as follows: Heavy mechanical construction throughout, large foundation area, heavy integral counter-shaft brackets, ease of replacing parts, ease of making repairs, small stored energy in the armature, superior commutation, heat-resisting insulation, and moving parts totally enclosed in the MD type. These motors are primarily designed for driving steel-mill auxiliaries, but they are also adapted to such applications as heavy-duty cranes, coal- and ore-bridges, unloaders, charging machines of all types, coke pushers, levelers, electric shovels, electric dredges, gates, valves, and small heavy-duty hoists. The bulletin points out that MDS motors differ from MD motors in having their upper half entirely open. A detailed description of all parts is given, tables of ratings, a key photograph and list of parts, as well as a number of photographs of actual installations on various types of mill and other machinery.

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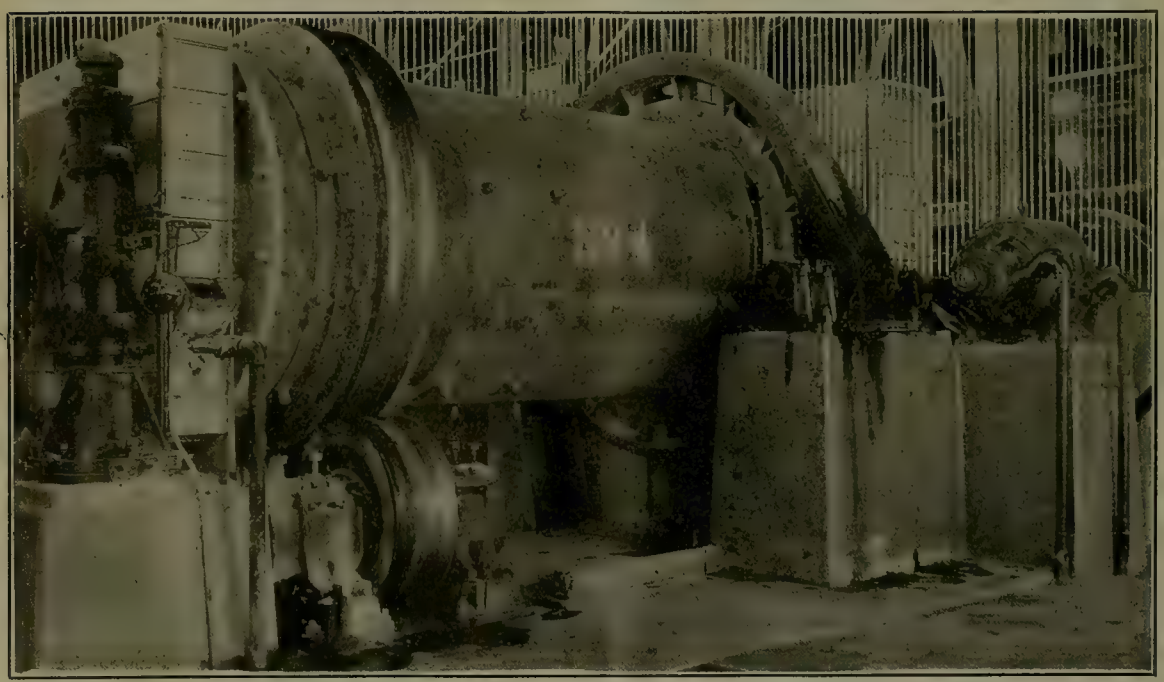


T. A. RICKARD, - - - - Editor

PRESIDENT HARDING'S public utterances recently have been much to the point. In a message to the special Fourth of July number of 'The Times' he emphasized the fact that a clearer understanding between the two great English-speaking nations "will prove the surest antidote to that unfortunate irritation which is too often caused by the actually unimportant but sometimes aggravating utterances of thoughtless demagogues and irresponsible agitators". Hearst papers please copy.

ON another page will be found a short article, describing an unusual copper-lead prospect, by Mr. W. L. Uglow, who is Professor of Mineralogy and Petrography in the University of British Columbia. Many of our readers will recall the fact that, in 1914, when Mr. Uglow was on the Geological Survey of Wisconsin, he was deputed to study the valuation and assessment of the zinc mines of Wisconsin for the State, and prepared a report that is one of the standard publications on mine appraisal. We welcome him to our columns.

COPPER continues to be quoted at a low price, but conditions are improving. We note that the Copper Export Association has called $1,000,000 of its 8% bonds for payment, at 101 and interest, on August 15. These bonds are of the series maturing on February 15 next year. The other bonds are quoted at par or slightly better. It is estimated that total sales for export during the first half of the current year have amounted to 115 million pounds, whereas our domestic production is now only 40 million pounds per month. Germany has been buying copper in increasing quantities.

ONE of the unexpected consequences of the Great War is the shifting of the world's coal trade from England to the United States and other countries. Before 1914 the English collieries distributed 80 million tons of bunker coal to foreign ports, this trade representing 75% of the British exports. Last year the coal exported amounted to only 24 million tons. In October last the price of coal to the British railroads was 42 shillings per ton, as against 17 shillings before the War. "To bring a ton of coal to the pit-head," says Mr. C. W. Barron, "costs on an average 31¼ shillings in Great Britain and 13 shillings in the United States." The higher cost is due to inefficient methods, the loss of so many of the best miners in the War, and the depth of the mines. Mr. Barron ends the article, in the 'Boston News Bureau', from which we have quoted, with the following statement: "The United States is the supreme power; not because it has the major part of the world's available gold; not because its national debt is less; not because of its wheat-fields, its cotton or its pork production; but because it has an equipped capacity to output for many generations 600 million tons of coal per annum and because more than two-thirds of the world's oil output is now American-owned".

IN this issue we publish an interesting review of metal mining in California during the current year. It is written by Mr. Charles G. Yale, of the U. S. Geological Survey, and therefore is amply authoritative. This review was written two months ago and has had to go to Washington, hence it is slightly out of date already in one or two details. For example, "the two most productive deep mines of the State" were shut-down late in June, as anticipated by Mr. Yale, but they have already resumed operation, we are glad to say. The reference is to the North Star and Empire mines at Grass Valley. Our own information is entirely in accord with that of Mr. Yale in regard to the expanding interest in gold mining in California.

AMMUNITION for the optimists, who are engaged in dispelling the gloom that prevails among their mining friends, may be found in the dividend for July recently declared by the Homestake Mining Company, of South Dakota. This is the third successive monthly dividend, since May, the last disbursement previous to that time having been made in September 1919. Some folks, with pessimistic perversity, argue that gold mining thrives most when times are dullest, and that the revival of prosperity for gold producers like the Homestake company is direct evidence that we are at the threshold of a period of greater depression as regards business in general. To them we venture to point out that it is the process of financial deflation that is painful, *not* the state of affairs that results when that process is finished. May not the revival of gold mining reasonably be interpreted as indicating the completion of this disagreeable, but apparently unavoidable, and manifestly desirable, deflation? We note that the Homestake company is now producing at maximum capacity and that the output for the current year is likely to exceed that of

1920 by $1,500,000. The Homestake is in many respects the greatest gold mine in the world. The ore averages only about $3.50 per ton; operations have been conducted continuously since 1878, during which time the production has exceeded $165,000,000, yet the prospect for the future is bright. Those who control the company have the habit of saying little regarding their enterprise; but the shipments of bullion to the mint, amounting regularly to about $6,000,000 per year, speak for them. The same may be said of the dividends, which, including that for July 1921, total $42,115,929.

Taxation of Mines

The temporary idleness of many mines is making trouble for, among others, the tax-collector. In Shasta county, California, for example, the representatives of the Mountain Copper, United States Smelting, and Balaklala companies have appeared before the Board of Supervisors to protest against excessive taxation. The County Assessor bases his levy on the cash-value of mining property, but what is the cash-value of a mine when the 'ore' in it cannot be exploited at a profit? For example, the Iron Mountain mine was valued, for taxation, at $549,000, whereas Mr. Albert Burch, as consulting engineer to the owners, the Mountain Copper Company, testified before the Board of Supervisors as follows: "Under circumstances as they exist today, I could not advise a client to buy the property at any price, because no money can be made out of it, but speculatively it might have a value perhaps of as much as $100,000." The reserve of 'ore', that is, of copper-bearing rock that under favorable conditions was labeled 'ore', is estimated at 260,000 tons, in the form of small lenticular masses averaging 2.38% copper. No gold or silver is associated with the copper. The manager, Mr. William Kett, testified that formerly the operating profit on this material was 80 cents per ton, but today the mining and treatment of it would involve a loss of $1.06 per ton; and this loss would not include overhead charges, depreciation, or general expense. If "former economic conditions were to return" the fair sale-value would be, say, $225,000, according to the evidence given. The return of such conditions, as of 1913, is suppositious. The question then arises: "Why should the value of a mine at a future date be made the basis of a valuation today?" The Assessor, it seems to us, is not justified in appraising the property upon an expectancy for which he can give no technical or moral justification. We feel sorry for him, presuming that he desires to be just, because he has to square his good intentions with the need for raising revenue, but we sympathize cordially with the officials of the mining companies in the protest against the attempt to shift the burden of county finance upon them. An idle mine, so long as it is idle, is of no immediate value; its speculative value will depend upon the anticipation of a resumption of profitable activity; while it is idle it is not a profitable asset and it should not be appraised as such by the Assessor. He, in behalf of the County, should take his share of the unpleasantness caused by adverse conditions, which are temporary, retaining the right to raise the valuation as and when the profitable operation of the mines is resumed. It looks as if the Assessor were trying to save the County from the effect of untoward industrial conditions by 'passing the buck' to the mining companies.

The Tariff Again

The Bill now before Congress has been stultified by the clause imposing an import duty on mineral oil. The inclusion of this proviso throws light on the mental dishonesty of the proposed legislation. In the first place, we have been told by various authorities, including the former Director of the Bureau of Mines and the present Director of the Geological Survey, that our oil resources are in danger of depletion and that therefore we ought to encourage "the participation of American citizens in the development of oil resources in many foreign lands". Good; therefore we ought not to export our oil to other countries; on the contrary, we ought to encourage the importation of foreign oil to us, thereby conserving our own resources and aiding our citizens, as in Mexico, in producing oil for shipment to our domestic market. Manifestly, an export duty is logical; whereas an import duty is the negation of common sense. Yet, even after the President, wisely and courageously, had urged the excision of the duty on oil, no less than 86 Representatives voted for it. The avowed principle on which the new tariff is constructed is protection, not revenue. The duties on oil, cement, lime, glass, aluminum, asphalt, steel, and hemp indicate the subordination of economics to log-rolling and political obligations; for much of the tariff represents the payment of the debt owed to those who gave financial support to the Republican party in the last election. Moreover the proposed plan for a valuation of imports based upon the price of similar products on the American market, instead of being based upon their cost to the importer, is a further and most effective check to international business, for it will have the effect in many cases of doubling the duty. Such *ad valorem* rates are open to unfair and arbitrary interpretation; they introduce a variable factor likely to injure the consumer no less than the producer. This feature of the new tariff illustrates again the subordination of wise statesmanship to parochial politics. The rates proposed under the new tariff are about the same as those levied under the Payne-Aldrich law; thus they disregard entirely the change in conditions caused by the War. By reason of that change the United States has ceased to be a debtor nation, and is now the great creditor nation of the world. Before the War the effect of a protective tariff on our export trade was negligible; now the two are so closely related that one may kill the other. Before the War about six billion dollars of European capital was invested in the United States, requiring therefore an annual remittance of about $200,000,000. If to this we add the expenditures of American tourists, freight, insurance, and other items, the total sum remitted abroad

annually was about half a billion dollars. That is one reason, among others, why our average excess of exports over imports between 1911 and 1914 was a little more than half a billion dollars. The War has reversed the position; we have loaned ten billion dollars to Europe, we have bought the American stocks and bonds that had been marketed abroad, and we are now entitled to receive rather more than $500,000,000 per annum. It cannot be paid in bullion; it can be paid only in commodities. Obviously the ideal arrangement is for the Europeans to send us what we do not produce, or produce less well than they do, and for us to send them what we produce, or produce better than they do. In short, as between creditor and debtor, it is desirable to trade in non-competitive products. This is not a time to incubate and coddle non-essential industries to the detriment of our commerce. Owing to the stimulus of the War we have been producing a surplus of certain commodities, including the metals; the export trade plays a large part in fixing the domestic price of such products; if our mining industry is to prosper we must find markets abroad, and that we shall be able to do only if we allow the importation of other products, chiefly manufactured materials. The so-called Latin-American countries can buy many things we produce, more particularly our manufactures, but they are producers of the metals, so that we cannot expect to sell them our surplus. The market for our excess production of metals is in Europe.

More Uses of Copper

Recently, apropos of the consumption of copper, we discussed sundry aspects of the electrical industry, particularly the impending expansion in the building of large interlocking systems of transmission and the further electrification of existing railroads. Rapid progress in both directions is assured. We understand that the Southern Pacific Company would electrify its Shasta division at once if it were practicable to finance the undertaking at the present time. In fact, the unfavorable status of the money market is the obstacle that postpones work on a number of large projects; there is no doubt from the engineering standpoint that the work will be done, and consequently that the required copper will be used. The copper miner cannot, nor need he, take any aggressive steps to stimulate the demand for his product for this purpose. There are, however, sundry industries in which copper was formerly an extremely important raw material but in which the use of inferior substitutes has lately become widespread. Among these may be named automobile manufacturing and the building industry; the latter requires metallic material for roofing, cornices, and plumbing and other interior fixtures. No well-informed person questions the superiority of copper and brass for a great many of the uses for which substitutes are now being employed; the manufacturers of automobiles know this and the architects and builders know it. What then are the reasons that prevent copper from regaining its former position? During the War it was difficult to obtain the metal for many purposes because of the rulings of the War Industries Board, which scrutinized closely every order that did not come from a Government department; moreover, the price of the raw material was high. Today, with a large surplus of refined copper selling at less than 13 cents per pound, the consumption in the industries mentioned is sadly disappointing to the producers. Mr. Ford used only 20 pounds of copper in his 1920 models; the average for all other automobiles was about 30 pounds. Manufacturers of some of the higher-grade machines used as much as 200 pounds of copper, including the copper content of the brass; and this feature of their construction is said to add much to the durability and reliability of the cars. It is safe to say that the cost of brass, as compared with that of the substitute metals, is the only factor that prevents its more general use in automobile manufacture. Although the same condition applies to the building industry, another factor enters into the problem, namely, the sentiment of the general public. If the producers of copper desire to increase the consumption of their metal in the building industry they must do two things: first, they must see that the copper and brass in the semi-manufactured form, that is, as sheets, plates, rods, and tubes, are obtainable at a cost proportionate to the market price of ingot copper; and, second, they must see that the public is impressed with the ultimate economy of using copper and brass, even though the first cost be slightly greater. It is, of course, out of the question for these materials to compete with inferior substitutes on the basis of first cost to the consumer.

It is difficult to justify the price asked for copper sheets, tubes, and similar products by dealers, even when the abnormal cost of fuel and labor required for the fabricating is given due consideration. Why should the wholesale cost to the user of a copper tube containing two pounds of copper be $1.80 whereas a steel tube of similar size and shape costs only 40 cents, when the difference in the value of the raw materials is not more than 25 cents? These figures are merely illustrative of a condition that actually exists today; they indicate that, somewhere between the refiner who produces the copper ingots and the dealer who sells to the consumer, an unwarranted profit is 'absorbed' by someone. From the standpoint of the miner and of the man who is building a house it matters little who gets the money. The first step for the copper producer seems to be some action that will put his product in fabricated form on the market at a reasonable price. Stating the case plainly, two courses are open to him: he must convince the present manufacturers and distributors that it is to their interest to co-operate in selling more copper, or he must do his own fabricating and his own distributing so that the consumer may get a square deal. Possibly the fabricators still have on hand products made of copper that was purchased at a war price; if so, the sooner they charge the difference to loss the sooner will copper commence to move. If they cannot be persuaded to do this, the only alternative seems to be for the producers to enter the field in competition. There are

objections to such a course, but they may easily be outweighed.

The second move for the producers is to educate the public by generous doses of propaganda; most of us have had so many kinds of this medicine that a little more can do us no harm. The man who is erecting a warehouse, an office-building, or a home, must be shown that he will save money in the end if he uses brass and copper instead of iron or steel or glass or tar or whatever the inferior substitute may be, even if the first cost be greater. If the architects and contractors appreciate the ultimate economy of the more costly material, why do they not exert themselves to guide their clients in the selection of copper products? The answer is that they have no incentive. The architect may make two estimates, one specifying copper or brass and the other some cheaper alternative material; the choice is made by the client, who generally has no definite knowledge of the comparative life of the two materials, and quite excusably selects the one that has the lower first cost. The man most interested in enlightening the public, the ultimate consumer, as to the superiority of copper and brass is the producer of copper. If he does not disseminate knowledge of the virtues of his product no one will. Evidently therefore the remedy for the present apathy toward copper, that exists among those who build, can be expressed in one word; advertise! As already pointed out, advertising is not required among makers of automobiles; they already know its merits. But both the automobile manufacturer and the builder need fabricated copper at a price that is in reasonable proportion to the cost of producing the raw material. We know that many of the producers of copper are fully alive to these conditions; we know that they have discussed these questions from every angle; but we are still waiting, we confess, with growing impatience, for some action on their part. The building industry has been in the doldrums for several years; it is certain to revive and to flourish with unprecedented vigor within the next year. Now is the time for the copper miner to do his missionary work. Europe will require copper; electrification of railways will require copper at home; other domestic industries will require copper; but the building industry is one that requires it now! It looks as though the copper producers needed an alarm-clock.

Indexing Current Technical Literature

In 1884, the late Professor J. B. Johnson, of Washington University, St. Louis, commenced the indexing of the material appearing in a few of the many publications devoted to engineering. These included the 'Engineering News', 'Van Nostrand's Engineering Magazine', the 'Journal of the Franklin Institute', the transactions of the American Society of Civil Engineers, of the American Society of Mechanical Engineers, and of the American Institute of Mining Engineers, together with the British publications, 'The Engineer', 'Engineering', and the proceedings of the Institution of Civil Engineers. This index appeared in the 'Journal' of the Association of Engineering Societies. In 1892 the first volume was published in book form, with the title of 'Engineering Index'. In the meantime the 'Engineering Magazine', a monthly publication, had been producing an index of a similar character. Amalgamation followed. The second issue of the 'Engineering Index' was published in 1896, under the editorship of Professor Johnson; subsequent volumes appeared until the close of 1918, two of which covered periods of five years each, the remainder appearing annually. Professor Johnson's efforts marked the initiation of the first serious attempt to classify periodical literature relating to engineering; the publication of each successive volume showed an increased scope. The 'Engineering Index' served its purpose during a period when specialization had not reached the stage in which one finds it today; thus, in 1906, the 'Index' contained only about 50 pages devoted to mining and non-ferrous metallurgy, out of a total of about 400. The book, however, was carefully prepared and edited; and credit is due to the sponsor of the work, Professor Johnson, and to the publisher, Mr. John R. Dunlap, for their enterprise. In 1918 the venture was absorbed by the American Society of Mechanical Engineers, which has since issued two volumes, for 1919 and for 1920, the second having come to hand this week. In these an attempt has been made, as formerly, to include mining and metallurgy, but with indifferent success; the principal cause for the failure of the book that lies before us is the fact that the compilation and classification of articles has been undertaken by one who is unfamiliar with these particular arts. For example, under 'Cyaniding' are indexed four articles only, three of which refer to the manufacture of cyanide, and the fourth to a paper on experiments to determine the delicacy of tests indicating the presence of minute amounts of cyanide. The book cannot be accepted as of real value to the mining and metallurgical professions; this is not strange, for it has been compiled by officials of the Society of Mechanical Engineers, who cannot be expected to appreciate the details of mining and metallurgy. It also contains much material in which we are not interested; our subjects require special treatment.

Early in 1911, the 'Mining & Engineering World', a weekly technical periodical published at Chicago, introduced an important innovation: a classified collection of references to current literature on subjects confined to mining, metallurgy, and allied topics. The index appeared in each issue, and constituted a useful addition to an otherwise feeble magazine; this was the first attempt to supply a long-felt want, and it was decided to publish the references in book form at semi-monthly intervals. Thus a hand reference book of current technology, from foreign as well as from domestic periodicals, was produced. Essential details were given, and in some cases a brief summary of the article was included. An index of subjects was supplemented by an index of authors—a feature that was (and is still) absent from the 'Engineering Index'. This added to the value of the

book. The task was performed by those who were evidently conversant with mining and metallurgical work in general; and a measure of success resulted. Unfortunately, however, the 'Mining & Engineering World' was absorbed by the 'Engineering & Mining Journal' in 1917, and its period of usefulness in this particular connection was brought to a close. The index ceased to be compiled, or to be published in book form, but the volumes already issued remain a source of information for the period 1911 to 1917; they constitute a monument to the only real attempt that has been made to index the current literature of mining and metallurgy, and to publish the information in book form. The 'Engineering & Mining Journal', for some years previous to the absorption of the 'Mining & Engineering World', had included in its pages, at monthly intervals, a mining index, but it was incomplete and poorly classified, and was evidently arranged by one who was not himself conversant with operations and processes. It failed to serve its purpose, and ceased to exist last year.

Among other attempts to classify current technical literature are the 'Index of Recent Papers', published in the monthly bulletins of the Institution of Mining & Metallurgy, of London, and the 'Mining & Metallurgical Index', published in the monthly magazine of the American Institute of Mining & Metallurgical Engineers. Both of these are confined to mining, metallurgy, and allied subjects. The index of the Institution is thorough, carefully prepared, but restricted in scope; that of the Institute is more ambitious, as far as quantity is concerned; it is stated that no less than 1300 papers and periodicals are consulted, but it contains no index of authors, and is not published in book form. In 1909, Dr. W. L. Crane brought out the 'Index of Mining & Engineering Literature'; this represented articles that had appeared in 18 publications. The entries contained no summary of contents of the contributions in question—a feature that is also absent from the index prepared by the Institute—so that, as a means of finding what was wanted, the book left much to be desired. It was not well edited, and contained no index of authors. The number of publications examined was small. Here we may remark that in many cases the title gives no clue as to the information to be conveyed by the author. The selection of apt and illustrative titles for contributions to technical literature is an art in itself. The great majority of authors have no idea of the importance of correct headings; few editors have either the time or the ability to find a satisfactory substitute for an ill-chosen title. Thus it is that matter of vital interest is indexed improperly, and is therefore inaccessible to the reading public. A second edition of Dr. Crane's book appeared in 1912; but the work failed to meet the demands of the profession and publication was discontinued. One of the best examples of abstracting work is shown in those pages of 'The Mining Magazine', of London, that were headed 'Précis of Technology' and are now named, less aptly, 'The Mining Digest'. However, this effort in no way represents a complete summary of current technical literature on so extensive a subject as mining and metallurgy; and although the abstracts form a valuable and interesting adjunct to the 'Magazine', they fail to function as a comprehensive index. From the foregoing it must be realized that there is an immense amount of duplicated effort in mining and metallurgical research and commercial operation, because of the difficulty that our technical men experience in keeping abreast of present practice or past achievement. We need, not only a complete index of titles, subjects, and authors, but a brief résumé of each contribution. Professionally speaking, we are in the backwoods, because of lack of scientific guidance and because of a failure to appreciate the fact that our methods are archaic. In the Engineering Societies Building, in New York, two staffs of separate engineering societies are engaged in an attempt to index the current literature relating to mining and metallurgy; the results are published separately; and both fail to meet requirements. If one quarter of the clerical labor that is involved could be placed under the direction of capable editors, and if specialists in the profession were to come forward with their aid as abstractors, we should have an index of current literature that would be of immense value in stimulating research, in preventing the overlapping of effort, and in directing attention to the vast amount of excellent material that appears in the technical press and in the transactions of domestic and foreign engineering societies, much of which is inaccessible because of faulty titles, improper indexing, and unsatisfactory classification.

At this stage of the discussion it is pertinent to observe that successful indexing and abstracting involve a high degree of analytical and literary skill, coupled with a specialized knowledge of the subject discussed by the author. It would be impossible to find any one individual who combined the qualifications, and who could perform such a task successfully; but by co-operation between the editor and the specialist it has been proved by our confrères, the chemists, that the work, if properly standardized and controlled, can be done well. The achievements of the American Chemical Society in this connection are noteworthy; its comprehensive and well-edited publications prevent duplicated research, and provide the members of the profession with all the information they need with regard to their own specialties as well as with reference to allied subjects. In metallurgy and electro-chemistry we turn often to the Chemical Society's publications for careful and instructive abstracts of all current literature on these subjects. The editorial activities of the Society are worthy of imitation. The monthly 'Journal' is a serious publication of original matter, in which there are no advertisements. Those in charge appreciate the fundamental principles of successful literary work; this is indicated by the fact that intending contributors are advised that "Papers should be submitted ready for publication, and in typewritten form. In preparing them the authors are requested to observe the utmost brevity consistent with clarity of presentation". The staff includes

an editor and 12 associate editors. But the Society's publication to which we wish to draw especial attention is 'Chemical Abstracts'; it is issued twice a month, and is of such a size and character as to suggest satisfactory binding in book form. Each semi-monthly issue is complete, with an index of authors. Attention is given to articles, books, patents, and to any mention of chemical or allied work. All details are recorded, followed by a brief abstract, which is well edited; the initials of the abstractor, whose full name appears in the honor roll on the front page, are appended. To carry this work to a successful conclusion there is one editor, who is assisted by 2 associate editors, 45 assistant editors, and about 250 abstractors. These figures indicate the direction in which the American Chemical Society prefers to expand its activities; it also shows that such work cannot be accomplished without the expenditure of a large amount of labor, aided by special technical knowledge. The result is that chemists and chemical engineers are supplied twice a month with a condensed account of every mention of each phase of technical endeavor in all parts of the world. This is of incalculable value to the industry, as well as to every member of the profession of chemistry. 'Chemical Abstracts' is also useful to the metallurgical engineer, for the activities of the chemist and the engineer overlap to such an extent that many details are of interest to both. The Society of Chemical Industry, through its 'Journal', has also done much toward indicating how abstracting and reviewing of technical literature should be done. In the chemical industry there has been keen competition between the two leading technical societies, and this has led to the attainment of a high degree of efficiency in publication work.

It is time that we of the mining and metallurgical profession insisted upon the abolition of that waste which marks the ineffectual efforts of the many to produce a satisfactory index and résumé of the current technical literature in which we are interested. The work that will be involved, as soon as we realize the necessity and the importance of the task, will be considerable; several hundred volunteers—each a specialist in a particular branch of mining or metallurgy, some of whom must be able to read a foreign language—are needed for the work of abstracting. If the chemists can find such men among their ranks, surely we can do likewise. The abstracts must be edited to conform to a standard style of diction, spelling, and abbreviation; they must be indexed, not only by title but by substance; and they must be prepared for frequent publication and in a manner that suggests preservation in book form, suitable for conservation as a permanent record. Such a magazine should not compete in any way with the technical press; the size of the page would make it too small for general advertising. A list of editors and abstractors would appear on the front page. In all such details we cannot do better than to copy closely the procedure adopted by the American Chemical Society. Our ranks contains the names of men who are second to none in technology and science. Hundreds of these should be willing to help forward such a scheme by a little work, which would at the same time put them into closer touch with their own special subjects. It is evident that the issuance of such an indexed précis of technology should be in the hands of the national society, in this case the American Institute of Mining & Metallurgical Engineers; if properly edited and arranged it should prove of infinitely greater value to the profession than the present monthly magazine, 'Mining & Metallurgy'. We hesitate, however, to make a suggestion of this kind, because it would call for more workers and fewer committee members, as well as special editorial and clerical staffs. The expansion of the Institute during recent years indicates a commercial growth. The new departure could doubtless be made financially successful, for a fortnightly publication of such a nature would be exceedingly valuable to every mining and metallurgical engineer, but its primary purpose would be to stimulate research and initiative, to prevent the overlapping of scientific and technical work, and to encourage an interest in the writings and achievements of others. The enumeration of these ideals will doubtless raise a smile in the Engineering Societies Building, but we believe that a large proportion of engineers are tiring of the craze for bigness, and are beginning to ask themselves whether discrimination, economy, and techno-scientific advance are not preferable to a world's record in membership and committees.

We would again remind those who may be interested that, if such a plan as we have outlined could be consummated, a large amount of intelligent and willing labor would be involved. Not only should each abstractor be in close touch with his specialty, he must be interested in it; he must see that all the available literature on the subject, and in the periodicals submitted to him, is represented in the index, so long as it is worth abstracting and so long as it deserves a wider audience. At present it happens often that an article is referred to or an abstract is made, whereas all subsequent criticism and discussion of the article remains unnoticed. In many cases the value of a contribution to technical literature lies almost entirely in the facts that are elicited during subsequent discussion. The abstractor must keep his eyes open for all references to the subject for which he is responsible. Abstracting is no mechanical operation; to be effective it must be performed conscientiously and with thoroughness. It should be realized also that the editorial columns of the technical journals often contain facts or comment that should be indexed or abstracted. We make mention of this because the majority of abstractors appear to think that such material, because it is unsigned, should be disregarded, whereas it is an integral part of the technical literature of the day. We have exceeded the space limit in drawing attention to a matter that should be viewed as one of vital import to the industry, but we have done so in the hope that our remarks will elicit the opinions of others, together with suggestions, from those who agree with our contentions, as to how the proposal can be put into more concrete shape.

Operations of the Engels Copper Mining Company—II

By Arthur B. Parsons

THE MILL. In a previous article the history of the Engels Copper Mining enterprise was reviewed briefly; the ore deposits in the two mines owned by the company were described; the methods of mining were discussed in some detail; and attention was drawn to sundry features of the mine equipment both underground and on the surface. The present article will deal with the concentration of the ore by froth-flotation in the mill at the Superior mine, one of the two neighboring mines owned by the company. This plant, at the time only partly completed, was first put into operation in February 1918. Additional equipment was installed during 1918 and 1919, and, in November of that year, when the old flotation plant at the upper mine was permanently shut-down and dismantled, the newer of two Minerals Separation machines, which had served there for two years, was moved to the Superior mill; here it supplemented the larger machine already in use. One 7 by 10-ft. tube-mill, one 8-ft. by 36-in. Hardinge mill, and two Dorr classifiers from the old mill also were moved to the new plant. Sundry minor alterations were made during 1920 to increase the capacity and improve the extraction. So far as crushing and grinding equipment is concerned the plant has a capacity of 1400 tons per day, but the flotation machines are inefficient when more than 1000 tons is being treated. Additional equipment will be necessary before the maximum tonnage can be concentrated economically. I shall describe only the new mill and the scheme of treatment in use at the present time.

COARSE CRUSHING. A small plant that merits brief attention is No. 6 Coarse-crushing plant, which derives its name from the fact that it is situated at the portal of No. 6 adit of the Engels mine. Electrically operated trains deliver the ore in mine-cars to an 800-ton flat-bottomed storage-bin above the crusher; the broken ore goes to a near-by bin at the loading terminal of the aerial tram that delivers Engels ore directly to the mill-bin. When the plant was originally designed, the ore was fed to the jaw-crusher by means of a wide horizontal belt-conveyor that ran lengthwise beneath the centre of the bin. This arrangement was unsuitable for the work, largely on account of the fact that the run-of-mine ore was coarse; chunks up to 200 and 300 lb. were common. The service was too severe for the belt and the labor required for operation was excessive. In re-building the plant, Robert A. Kinzie, who directs the operations of the company, replaced the conveyor and apron-feeders with a Meese & Gottfried pan-conveyor 36 in. wide and 52 ft. long from centre to centre of the head and tail pulleys. There are three openings at equal intervals along the length of the bin where ore can be withdrawn to feed the conveyor; the feed-hopper is mounted on a track in such a manner that it can be moved to any of the three, the two not in operation being shut by horizontal steel gates. This permits the long narrow bin to be nearly emptied without shoveling, although ordinarily there is sufficient ore in the bin to make the moving of the feeder unnecessary. Another change was the housing of the motors in separate buildings. The crusher is 18 by 36 in., Blake type, manufactured by the Allis-Chalmers company. The bearings and the toggle-eccentric are water-cooled; the jaws are of manganese-steel. A 150-hp. Westinghouse induction motor supplies power for the crusher and the conveyor. A short inclined belt-conveyor carries the ore to the 450-ton bin at the tram-terminal. As it is now built this little plant crushes from 80 to 100 tons per hour with a maximum jaw-opening of 5 in.; the operation is smooth and economical. The ore from the Superior mine is hoisted in 5-ton skips that dump directly at the head of the mill into the 837-ton steel storage-bin, this being the same bin that receives the Engels ore as it is emptied from the buckets of the tram.

MILL-BUILDING. This is a frame structure; the sides are of 'rustic', painted light gray, and the roof is covered with asbestos roofing supplied by the Johns-Manville company. The timber and lumber were all cut in the vicinity of the mine by the company in its own saw-mill. The question naturally arises why structural steel and corrugated sheets were not used; the answer is that it was practically impossible to get steel at the time (1917-'18) when the plant was being built, whereas timber was available immediately. Moreover, time was an important factor; the completion of construction as soon as possible was desired on account of the high price of copper then obtainable. It will be observed from the accompanying illustration that the mill-site is unusually steep; there are more than a dozen benches with numerous concrete retaining-walls. Much of the underlying surface is solid rock; accordingly, massive concrete foundations are few. The ore-bins, one for coarse and four for fine ore, are of steel plate, 30 ft. high and 24.6 in. diameter with an available capacity of approximately 700 tons each. The plant was designed by Bradley, Bruff & Labarthe, and that firm supervised the erection.

A feature that may, I think, be called unique is the building of the entire plant so high up the hill that the concentrate must be lowered 100 ft. vertically from the filter-floor to the railroad. The illustration shows the housing of a steeply inclined conveyor below the main portion of the mill-structure. This is so steep that the comparatively dry concentrate rolls down the belt, thereby requiring constant attention and increasing the cost of handling. It is apparent too that there must be great waste in time and power in carrying supplies up the hill, and in the time of employees going to and from the warehouses and shops that are situated below.

The reason assigned for selecting the site is that it made possible a gravity flow of tailing to the impounding dam, a mile down the canyon. The laws of California make it obligatory to clarify the waste-water before it is returned to the stream and for this purpose a settling-plant consisting of a series of classifiers and an 80-ft. Dorr thickening-tank was built above the dam. The desire to have the tailing flow by gravity to this tank determined the choice of the site. It seems probable that the cost of pumping the tailing a short distance would be more than offset by the other apparent savings. W. R. Lindsay, the superintendent, does not agree with this view; and it must be admitted that the calculation of the net financial loss arising from lost time is hard to measure. Workmen need rest occasionally, and it may be that the time consumed in waiting for the tram, and in riding on it, supplies this need. The two tram-cars that serve the mill are operated by electric hoists on tracks that can be seen on either side of the plant.

Crushing. The equipment for crushing consists of one No. 8 Traylor gyratory, two No. 5 McCully gyratories, and one set of Superior rolls, 54 by 24 in. These are arranged at the present time as indicated in the accompanying flow-sheet. The trommel makes three products of the following sizes: (a) through 1-in. round holes, (b) through 2-in. holes, and (c) oversize. The oversize goes to the rolls for re-grinding; the 2-in. and 1-in. products are divided between the storage-bins for the Marcy and Hardinge mills.

A second trommel is being added; when it is complete both will be equipped with 1-in. screens exclusively, and the rolls and trommels will be arranged in closed circuit; the rolls will be operated with a choke-feed, thereby increasing their capacity. The change in feed will likewise be beneficial from the standpoint of efficient grinding because of the less ratio of dimunition required of the ball-mills.

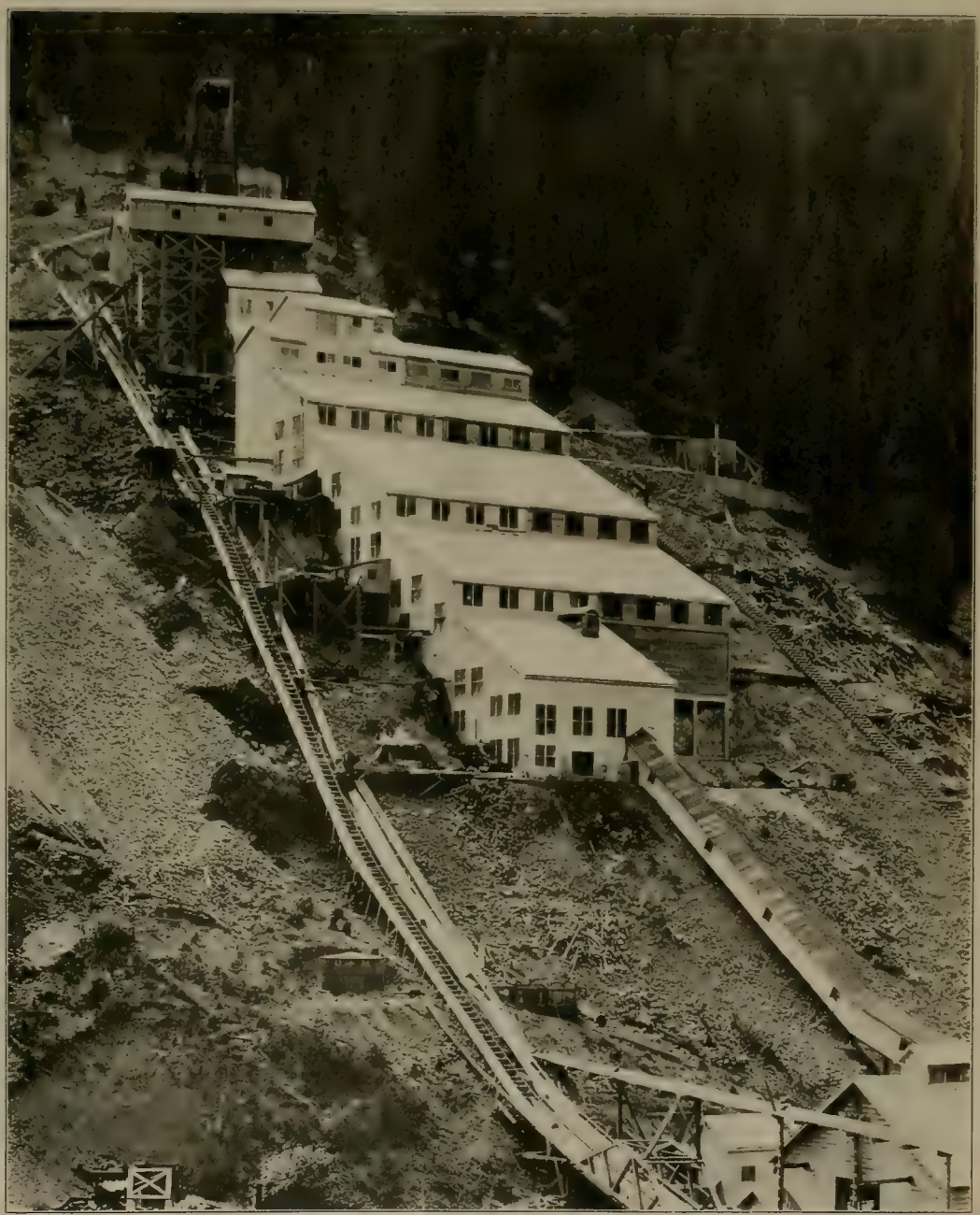
A few notes on the crushing equipment may be of interest. Ore from the 'coarse' bin is fed by means of a 30-in. Meese & Gottfried pan-conveyor operating in a tunnel through the foundation of the tank. Like the conveyor beneath the bin at No. 6 crushing plant, it gives excellent satisfaction. The Traylor crusher, breaking the ore to pass through a 3-in. slot, has given good service, but the No. 5 McCully gyratories do not appear to be rugged enough for the work expected of them; trouble has been experienced with the cracking of both the upper and lower halves of the shell. It must be admitted that the ore is unusually hard and tough, especially that coming from the Superior mine, but it is hard to believe that the ore itself accounts for the repeated breakage. At present there is no means for removing 'tramp' iron except that the operator picks out pieces by hand when he happens to see them. Although I am assured that the cracking has not always been caused by stray chunks of metal, it is significant that plans are already made to provide a magnet to assure the removal of hammer-heads, drill-bits, and such scrap, which are always found in ore, and some of which are almost certain to escape the attention of the crusher-man, whose duties take him away from the crusher at times. The relative position of the crushers and bins and the arrangement of chutes, set in concrete, is peculiar and has delayed the installation of a magnetic device. Concaves and heads for the gyratory crushers are made of manganese-steel.

The roll-shells are likewise of manganese-steel. An unusual feature is the sectional construction. There are nine arc-like segments each independently attached to the roll by means ofa curved bevelled 'mortice' with a filling of zinc. These shells have proved entirely satisfactory from an operating standpoint in spite of some apprehension at the outset that a single segment might become loose and wreck the entire machine. They are expensive, of course; a complete set at war-time prices for steel cost $3000. The cost per ton of ore crushed will not be known until the first set is worn out, but, judging from the tonnage that has passed through the rolls already, the net cost will be comparable with shells of cheaper material, particularly in view of the present lessened comparative cost of manganese-steel.

The rolls were run formerly at 110 r.p.m.; by reducing the speed to 54 r.p.m. the consumption of power was diminished by 40% and the capacity was increased. The crushed ore goes to the appropriate steel-tank storage-bin as indicated in the flow-sheet. It will be observed that the crushing part of the plant is a distinct unit; either the crushing department or the grinding-flotation department can be run independently of the remainder of the mill. This arrangement has obvious advantages, especially as the storage capacity of the four bins is equivalent to several days run, thereby affording desirable elasticity in operations.

Grinding. The ore from two of the bins is fed to the mills by means of 18-in. pan-conveyors and from the other two by means of 30-in. belt-conveyors; the latter do the work just as well and are preferable because of cheaper maintenance. This emphasizes clearly the need for selecting the equipment that is most suitable for the particular service. Mention has been made of the fact that the run-of-mine product could not be efficiently moved by means of a rubber belt; on the other hand, the crushed ore is handled most economically on a belt.

The Marcy mill (No. 86) and each of the three 8-ft. by 36-in. Hardinge mills is followed, in a separate unit, by either a 6 by 12-ft. or a 7 by 10-ft. tube-mill or a Hardinge mill used as a re-grinder; for convenience, each of the eight mills is arranged so that it may be run in closed circuit with a 6 by 21-ft. Dorr classifier. Usually, however, the coarse product from the primary classifiers forms the feed for the re-grinders. The detailed arrangement may be seen on the flow-sheet. One of the classifiers is a type C machine; the others are type D. The experience here has been that the heavier machine, type D, is far more satisfactory. One reason for this is the fact that the machines have been speeded up to 23 strokes per minute, as compared with a normal of 18 to 20, with the purpose in view of causing sufficient agitation to maintain an overflow in which 10%, by dry weight, of the



NEW MILL OF THE ENGELS COPPER COMPANY

SETTLING-TANK FOR MILL-TAILING

TRAMWAY FROM THE UPPER MINE

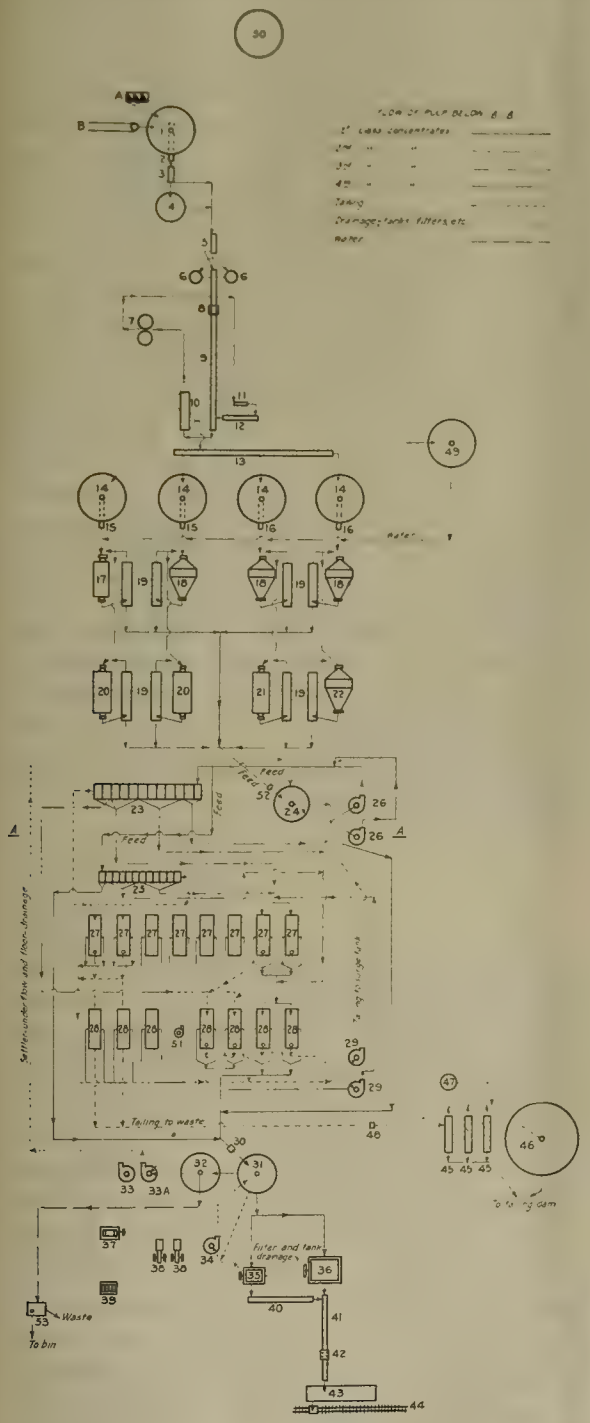
TRAMWAY-TERMINAL AND HEAD-FRAME AT THE SUPERIOR MINE

TRAYLOR GYRATORY CRUSHER

SILENT-CHAIN DRIVE FOR BALL-MILL

solid material is coarser than 100 mesh. The desirability of this will be mentioned in the discussion of flotation. The Marcy mill is equipped with manganese-steel liners and chrome-steel screens, and is fed with 5-in. chrome-steel balls.

The Hardinge mills are provided with chilled-steel liners and chrome-steel wedge-bars. It has been found, however, that soft spots in the chilled steel wear rapidly to the shell of the mill, thereby necessitating replacement when as much as 60% of the entire liner remains. Economy of material and of time in repair-work will be effected by substituting chrome-steel liners. This is now being done as current replacements become necessary. The re-grinding mills are fed with 2-in. Duroloid balls furnished by the Los Angeles Foundry Co. They have been found by competitive tests to be the most economical ball available.



FLOW-SHEET OF THE NEW MILL

All the mills are driven by individual motors; the Marcy and tube-mill motors are direct-connected to the pinion-shafts, whereas the Hardinge pinion-shafts are connected to 150-hp. motors by short-chain drives. Two of these are of Link-Belt manufacture and the third is a Morse silent-chain drive. All of the chains run in No. 3 Keystone grease and are thoroughly protected from dust and dirt by metal housings. The Marcy-mill pinion was manufactured by the Fawcus Machine Co.; those on the tube-mills are of the Falk type. The wear on the pinions was materially lessened by using Gearshield, made by the Ironsides Manufacturing Co. Some pinions formerly lasted only three months; similar pinions running in Gearshield are still in service after a year of operation.

Mr. Lindsay and W. I. Nelson, general foreman of the mill, are obtaining data for publication from a complete series of tests to determine the efficiency of the various grinders and re-grinders. From these I have taken the following figures, the particular tests recorded having been made with the Marcy mill followed by tube-mills. When handling 2-in. feed one 6 by 12-ft. tube-mill was sufficient, whereas with 1-in. feed, two tube-mills were required to grind the oversize from the Marcy.

Size of feed	Finished product, tons	Power input, kw.	Power input, kw-hr.	Kw-hr. per ton ground
2-in. ring	443.97	281	6744	15.1
1-in. ring	866.10	387	9288	10.7

These figures reveal two interesting facts: the decided

Legend of Flow-Sheet

A. Shaft at the Superior mine
B. Riblet aerial tram
1. Steel ore-bin, 850 tons
2. Pan-conveyor, 30-in
3. Grizzley, 3-in. openings
4. Traylor gyratory crushers, No 8
5. Grizzley, 1½-in. openings
6. McCully gyratory crusher, No 5
7. Superior rolls, 54 by 24-in.
8. Conveyor weightometer, Merrick
9. Belt-conveyor, 24-in.
10. Trommel, 38 by 14-in.
11. Bucket-elevator, 18-in.
12. Belt-conveyor, 16-in.
13. Belt-conveyor, 16-in.
14. Steel ore-bins, 850 tons each
15. Pan-conveyors, 18-in.
16. Belt-conveyors, 30-in.—24-in.
17. Marcy mill, No. 86
18. Hardinge mills, 8-ft. by 36-in.
19. Dorr classifiers, 6 by 21-ft., type D
19A. Dorr classifier, type C
20. Tube-mills, 6 by 12-ft.
21. Tube-mill, 7 by 10-ft.
22. Hardinge mill, 8 ft. by 36 in.
23. Minerals Separation machine, type A2, 24-in.
24. Dorr thickener, 20 by 10-ft.
25. M. S. machine, type G, 18-in.
26. Centrifugal pumps, Krogh, 6-in.
27. Callow roughers
28. Callow cleaners
29. Centrifugal pumps, Krogh, 3-in.
30. Automatic sampler, concentrate
31. Dorr thickener, 16 by 16-ft.
32. Concentrate collecting-tank, 16 by 16-ft.
33. Centrifugal pump, Krogh, 3-in.
33A. Centrifugal pump, Krogh, 2-in.
34. Centrifugal pump, Krogh, 3-in.
35. Oliver filter, 8 by 6-ft.
36. Oliver filter, 12 by 8-ft.
37. Sturtevant blower, No. 8
38. Vacuum pump, Doak, 14 by 8-in.
39. Sturtevant fan, with heating-stack
40. Belt-conveyor, 12-in.
41. Belt-conveyor, 12-in.
42. Conveyor weightometer, Merrick
43. Concentrate storage-bin
44. Indian Valley railroad
45. Esperanza classifiers
46. Dorr thickener, 80 by 16-ft.
47. Lime-mixing tank, 4 by 5-ft.
48. Automatic sampler, tailing
49. Mill-water tank
50. High-pressure tank, for fire
51. Centrifugal pump, 2-in.
52. Automatic sampler-heading
53. Settling-tank

decrease in the gross power consumption per ton of ore crushed; and the increased capacity obtained from the ball-mill—both being accomplished when finer crushing has been effected in the rolls. Three mills are required instead of two but the increased capacity of the three-machine unit is far out of proportion to the additional cost of balls and liners, and the labor for repairs and operating attendance, that the third mill entails. In order to study intelligently the merits of finer crushing in the rolls it will be necessary to analyze all the elements of cost in both roll-crushing and subsequent grinding. If a new plant were to be erected the factor of capital expenditure would have to be considered but in this instance Messrs. Lindsay and Nelson will confine their investigation to the actual operation and maintenance of the present equipment. The results should be interesting as well as valuable.

The following figures cover the operations of the year 1920, for all the mills:

Material	Total weight used, lb.	Consumption per ton of ore milled, lb.
Balls, 5-in.	380,452	1.588
Balls, 2-in.	219,778	0.917
Liners	126,610	0.528

FLOTATION. The overflow from the eight Dorr classifiers is automatically sampled as it passes to a 20 by 10-ft. tank, provided with Dorr thickener rakes, in the flotation department. This tank serves as a collector and is called a 'surge' tank for the reason that it absorbs surges in the flow of pulp to the flotation machines; in other words, it provides a feed for the machines that is uniform, both in quantity and in dilution. Freedom from sudden fluctuation is recognized as essential to good concentration by flotation and this scheme for obtaining it has proved highly effectual. Besides the overflow from the classifiers, tailings from the cleaner-cells and accumulated pulp from a clarifier enter the surge-tank; there is no overflow, but the level of the pulp is maintained at a point 15 or 20 in. below the top by the withdrawal of the flotation feed through the central discharge at the bottom of the tank. A six-inch centrifugal pump lifts the pulp more rapidly than is required for the flotation machines, the excess joining the feed to the surge-tank. Additional agitation and mixing are thereby obtained.

Sodium hydroxide was used formerly as a flotation reagent; it had the effect of stiffening the froth and improved the extraction somewhat, but coincidentally there was some diminution in the grade of the concentrate. It was found to be more profitable to discontinue the using of the hydroxide. The method of introducing oil is peculiar; three mixtures are prepared using the following ingredients.

A. Diesel oil, 24°B. fuel-oil from the Standard Oil Co.

B. No. 14 crude pine-oil high in turpentine.

C. No. 7 fuel-oil, standard grade.

D. Kerosene oil.

The mixtures are:

	No. 1 %	No. 2 %	No. 3 %
A	..	85	40
B	15	15	35
C	75	..	25
D	10	..	..

The former practice was to use a standard mixture of B, C, and D. However, it was found that variations in the character of the ore were sufficient to require changes in the constituent proportions, if the best results were to be obtained; the various mixing formulas were accordingly developed. According to Mr. Nelson, the froth that formed when using a mixture of C and B was tough, and the grade of the resultant concentrate was low. Diesel oil (A) in combination with pine-oil (B) produced a clean froth or concentrate, but if the proportion of oil in the pulp fell below the ideal amount the froth could not carry the sulphides and a high tailing resulted. On the other hand, an excess of oil could be used without making a noticeable difference in the condition of the froth, thereby causing a needless use of oil. For these reasons the fuel-oil (C) is added to the mixtures, which are so devised that a wide range in the proportions of A, B, and C oils may be obtained by adding different amounts of No. 2 and No. 3 mixtures.

No. 1 is added at the head of the Marcy mill; No. 2 and No. 3 at the tube-mills, or, if necessary, in the first compartment of the flotation machine. Control of the oil-feed is centralized at one point near the machines so that the operator is able to make adjustments easily and quickly. It is desirable to add as much as possible of the amount required before the Minerals Separation machines are reached, for the reason that raw oil kills the froth. However, an excess of oil is to be avoided, and accordingly the practice is to keep safely on the 'low' side in the mills and to make up any deficiency by adding some of the mixture, richest in frothing-oil, in the cells. This scheme of proportioning and adding the oils is unusually complicated, but the good results seem to answer any criticism.

During the month of March 1921 the amounts of the various oils used were as follows:

	Amount used per ton of ore milled, %	Proportion of total, %
A	0.5945	51.91
B	0.2895	25.28
C	0.2443	21.33
D	0.0170	1.48

The M. S. equipment consists of one new 12-compartment, 24-in. type A-2 machine, and one 12-comparement 18-in. type G machine salvaged from the old mill. They have been modified slightly by providing adjustable redwood gates to regulate the flow between compartments, together with a curved baffle, beneath the opening from the mixing into the frothing-chamber, which deflects the pulp upward and lessens the tendency of particles to go from cell to cell without getting into the zone of frothing.

The two Minerals Separation machines operate in parallel, each making a finished concentrate, and three additional products that are re-treated in Callow cells. These cells have been altered by placing a false bottom above the former bottom to reduce the slope; the fall now is 25 in. in 8 ft., as compared with 36 in. Formerly the blower tended to overheat. One cell was remodeled without any ill effect on the results, and accordingly the others were re-built in the same way. Air is introduced

through eight canvas-covered cast-iron pans each 12 by 24 in., provided with individual air-pipes entering the pans from the bottom.

Numerous changes have been made in the flow-sheet for this part of the mill and still others are planned. However, the flow illustrated herewith has given consistently good results.

It will be noted that the final tailing comes from only two cells; likewise that only two cells make a finished concentrate. The others serve as roughers to make intermediate products for return to the surge-tank or for further treatment in other cells. The question may be asked why the final cleaning of the tailing is done in only two Callow cells when a number of others are idle. As a matter of fact, when a decreased tonnage is being crushed, one of these two cells is cut out and the entire flow diverted to a single cell. This procedure is based on the theory, doubtless sound, that unless the quantity of oil and of floatable mineral in a cell exceeds a fixed amount, the froth formed will not be sufficiently enduring to overflow the cell. No oil whatever is introduced beyond the point where the pulp enters the M. S. machines.

Krogh centrifugal sand-pumps are used exclusively for returning pulp. The lining and impellers are made of special white iron. In order to minimize variety in sizes of repair-parts, pipe, and fittings, three-inch pumps are used throughout, with the exception of two 6-in. pumps for transferring pulp from the surge-tank to the flotation machines. A measure for efficient operation is the providing of duplicate pumps so that no delay need result from the temporary shutting-down of one pump for repairs. Another item of standard equipment is the Merco-Nordstrom plug-valve; it costs less than a gate- or globe-valve, is fool-proof, lasts longer, and is free from the two great defects of the ordinary cock, namely, liability to leak and to stick so that it cannot be turned. So well liked are the Merco plug-valves that they are being introduced also in the mine.

Filtration of Concentrate. The concentrates from the two M. S. machines and from the Callow finishers combine in a single launder, and, after being sampled, flow to a collecting and dewatering tank, 16 by 16 ft., provided with Dorr rakes. The overflow from this tank goes to a second tank similar to the first except that it has no rakes; periodically the settled sludge from the second tank is pumped back to the surge-tank while the overflow passes through a square settler and to waste. The overflow from the Dorr tank is not clear; as a matter of fact, it is essential that it be not clear, for the reason that the concentrate contains an undesirable proportion of 'colloidal' material, mostly silica, which seriously interferes with efficient filtration, but which will overflow from the Dorr tank if it is given the opportunity. Some of the colloidal silica settles in the second tank and is pumped back, but it does no harm.

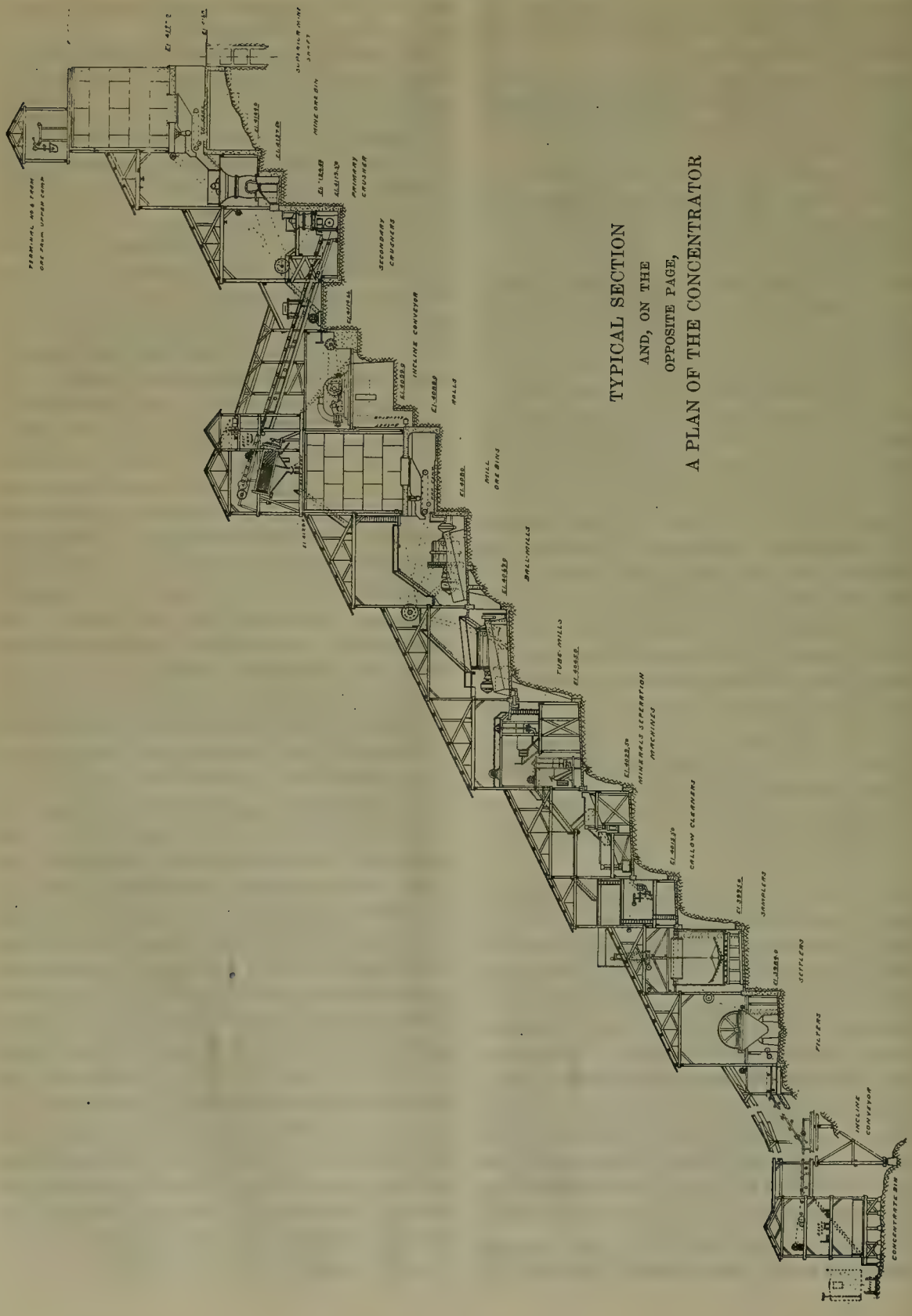
One 12 by 8-ft. Oliver filter dewaters the concentrate produced at present without difficulty, but an 8 by 6-ft. Oliver is to be installed to provide increased capacity, and likewise to serve in emergency.

Colloidal slime clogs the fabric of the filter cover and tends to make an impervious cake; the result is a thin and wet cake, or, in other words, low capacity and high moisture. This is avoided (1) by removing as much of the colloidal matter as possible by keeping the contents of the thickener slightly agitated and (2) by maintaining a flotation feed in which the plus 100-mesh material forms approximately 10% of the total. In addition, the pulp withdrawn from the thickener is kept thick, the ratio of solid to water being not less than 1:1. The result is a cake varying in thickness from ¾ to 1¼ in. and in moisture content from 10 to 15%. A No. 12 M. S. canvas cover supplied by the Oliver company has an average life of five months of effective filtering. It has been found desirable to heat the pulp in the filter with steam in order to keep open the pores of the cloth.

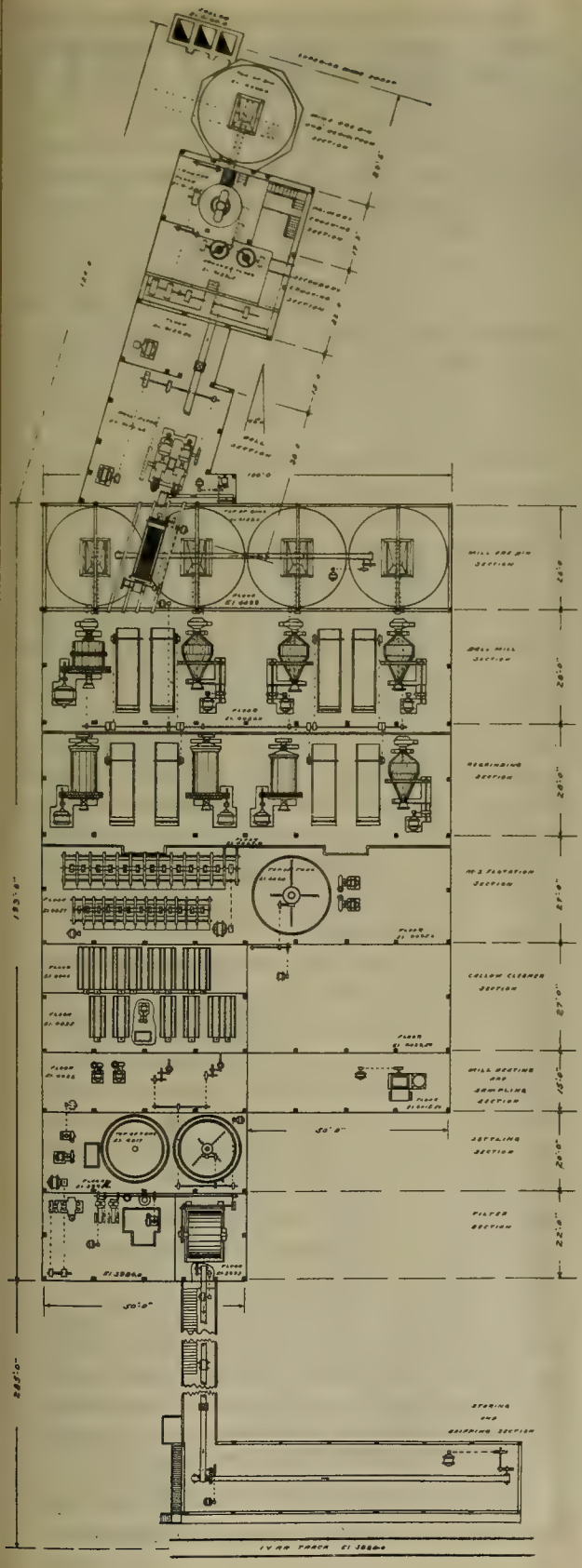
There is no question but that finer grinding would result in a higher extraction in the flotation department, but here an economic balance must be struck. There is no profit in recovering a few additional ounces of copper, per ton of ore, if the added cost of grinding and filtering, and freight on extra moisture, will more than equal the revenue from the copper saved. The final test of good metallurgy is financial gain—not low tailing nor even high-grade concentrate. It is the task of the wise metallurgist to determine the method of concentration that will net the greatest profit. The operation of the Engels mill is a good illustration of the correct recognition of the wisdom of such a policy.

Miscellaneous equipment in the flotation department includes: duplicate vacuum pumps, 14 by 8 in., manufactured by the Doak Gas Engine Co.; a No. 8 Sturtevant blower for the Callow cells; and a Sturtevant fan used in conjunction with a steam-heating system for the mill.

Concentrate from the filter falls through a steep chute onto a 12-in. belt-conveyor that carries it down a 34° incline into the storage-bin adjacent to the railroad side-track. It is this conveyor that was mentioned earlier in the article as requiring constant attention because of the tendency of the partly-dried concentrate to roll off the sides of the belt. Mr. Kinzie recently has designed an arrangement in which a belt-conveyor, operating at a practicable inclination, will be combined with a vertical chute to transfer the concentrate. If the plant were to be re-designed the filtering department would doubtless be at the bottom of the hill beside the railroad track. The filter-floor would be at such an elevation as to provide conveniently for the delivery of the concentrate by gravity either to storage-bins or directly to the cars. The concentrate, as a pulp, would flow to the filter-plant through pipes or launders and the clear filtrate would be pumped back, or not, as desired. Obviously, this scheme depends upon the assumption that the mill-structure proper would be placed in its present position far above the grade of the railroad instead of near the bottom of the slope.



TYPICAL SECTION
AND, ON THE
OPPOSITE PAGE,
A PLAN OF THE CONCENTRATOR



From the present storage-bin, box-cars are loaded with concentrate by wheel-barrow for shipment over the Indian Valley and Western Pacific railroads to the Garfield smelter in Utah.

The disposal of the tailing is complicated by the law prohibiting the contamination of streams with muddy water. Accordingly, a dewatering plant has been constructed above the concrete tailing-dam. The stream from the main flume flows into the first of three Esperanza classifiers arranged in series; these remove a large proportion of the sand, leaving the thin slime to flow into a 16 by 80-ft. tank equipped with Dorr thickener rakes. Lime emulsion is added to assist settling, the proportion during 1920 averaging 1.76 lb. of dry lime per ton of ore milled. The present storage-area is not adequate and it is difficult and expensive to maintain a clear overflow from the ponds to the creek; moreover this will be aggravated when the anticipated increase in tonnage treated is realized. The work of building new settling-ponds in the Stark ranch, owned by the company, is progressing; when this is concluded a material reduction will be effected in the cost of dewatering, which during 1920 amounted to $0.1699 per ton of ore milled.

The metallurgical results are determined accurately. To ascertain the tonnage, two Merrick weightometers are provided: the first records the weight of the ore carried by the belt-conveyor between the No. 5 crushers and the rolls; the second weighs the concentrate but serves only as a check, for the extraction made at the mill is calculated from the actual weight determined at the smelter and from the assays on which settlement is made. Particular care is taken with the moisture sample of the mill-heading.

Pulp samples are taken automatically at three points by intercepting the flow in (1) the main launder leading to the surge-tank; (2) the concentrate launder leading to the filter feed-tank; and (3) the tailing flume. The automatic sampling devices are of the swinging type, carefully designed to obtain a fair sample. They are actuated through reducing-gears by the mill-machinery, but are constructed in such a manner that, when released, the 'cutter' will complete its swing even though the power may 'go-off' and shut-down the plant. Many samplers of this type have the fault of coming to rest near the centre of their swing, thereby catching the drainings from the launder until power is restored. The accuracy of the weightometers is verified by actual weighing at intervals of several weeks, when they are re-calibrated if necessary; the machine weighing the heading gives consistent results and is particularly reliable.

The following data summarize the mill results for 1920:

Ore milled, tons	239,612
Average heading assay, copper, %	2.21
Average tailing assay, copper, %	0.4514
Concentrate produced, lb.	28,799,796
Average concentrate assay, copper, %	29.76
Copper in concentrate, lb.	8,571,571
Silver in concentrate, oz.	119,165.42
Gold in concentrate, oz.	1,217.872
Actual extraction, %	80.93

The itemized cost per ton during 1920 is shown in the following table:

Account	Operation	Repairs	Total
Crushing	0.0467	0.0489	0.0956
Classifying	0.0023	0.0042	0.0065
Rolling	0.0001	0.0058	0.0059
Grinding	0.1621	0.0856	0.2477
Re-grinding	0.0882	0.0214	0.1096
Conveying	0.0092	0.0070	0.0163
Pumping	0.0044	0.0153	0.0197
Concentrating	0.0923	0.0132	0.1055
Filtering	0.0262	0.0104	0.0366
Dewatering	0.0714	0.0985	0.1699
Power	0.2909	.....	0.2909
Assaying	0.0086	.....	0.0086
General	0.0146	.....	0.0146
Heating and lighting	0.0816	.....	0.0816
Boarding-house loss	0.0317	.....	0.0317
Total	0.9303	0.3103	1.2407

Power. Aside from that supplied by a 350-kw. hydro-electric generating unit, power is purchased from the Great Western Power Co. The first transmission line, completed in 1915, was 45 miles long, connecting with the Butt Creek power-house; the construction was partly financed by the Engels company. When the erection of the new mill was definitely decided upon, arrangements were made with the Power company to construct a second line from the Las Plumas plant. Current is transmitted 57 miles at 44,000 volts to the Veramont sub-station; thence 10 miles to the mine at 22,000 volts. The transmission lines pass through timbered country for the most part and the service until recently was not efficient; the supply of current was interrupted frequently. Moreover, the rates in the existing contract were not favorable to the mining company. During 1920 Mr. Paxton devoted a great deal of time to litigation, hearings before the Railroad Commission, which determines rates for all public utilities in California, and negotiations with the power company; the outcome was a compromise agreement dated December 9, 1920. By the terms of this agreement the Great Western company undertook to spend $5000 on improvements to the Las Plumas line; pending lawsuits for damage suffered by the Engels company were dropped; and a new five-year rate-contract was signed. Since January the service has been improved and the average cost per kilowatt-hour has been reduced from 1.6 cents to approximately 1.0 cent, thereby effecting an estimated annual saving of about $50,000.

Industrial Relations. The company owns the land on which the mine settlements are situated and enjoys the advantage of entire control over its employees; the policy is to make conditions as satisfactory as possible. Running water and electric lights are provided in 120 cottages reserved for the use of married men and their families. These cottages have from 3 to 5 rooms and make first-rate homes. Eight dormitories have been built for men without families. The newest one is a two-story building designed to accommodate 66 men, two in each room. Steam-heat and electric lights are provided, and the beds have comfortable springs and mattresses with blankets, sheets, and pillow-cases, supplied by the company. The atmosphere is very different from that of the bunk-house that was so common in our Western mining districts a few years ago.

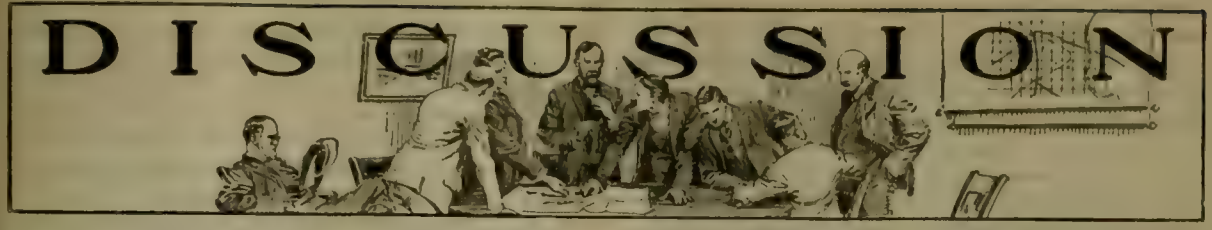
At the company boarding-houses clean wholesome food is served in attractive dining-rooms. Mining companies, with few exceptions, have always served good food, and this tendency has become more marked during recent years. It is the boast of about one manager in every three that he feeds his men better than any other mine in the particular State in which he happens to be; accordingly, comparisons are not particularly convincing to those familiar with the subject. However, during 1920 the average cost to the Engels company of operating the boarding-houses, exclusive of dormitory expense, was $1.55 per man per day, which ought to support my statement, based on personal observation, that an exceptionally good table is set. The employees are charged only $1 per day for board and lodging, the deficit that accrues being made up by the company, being charged directly to operation.

A commodious recreation hall, completed in 1918, is equipped as a reading-room, card-room, and billiard-hall; dances and motion-picture shows are held here one or two evenings each week. Employees purchase merchandise in the company's general store at prices based on the invoice cost plus the actual expense of conducting the business. Englemine also boasts a good school-house.

Prior to 1920 the turnover of labor at the mine was extremely high in spite of the endeavor on the part of the company officials to provide comfort and recreation for the employees. The completion of the new dormitory during that year assisted in simplifying the labor problem, but the influence of a surplus of job-seekers throughout the country should be recognized as an important factor. At the present time a stable, efficient, and apparently well-satisfied force of about 400 employees operates the mine and mill. The various foremen seem to co-operate to excellent advantage under the leadership of Mr. Lindsay.

It may be of interest to mention the men who are officially identified with the affairs of the company, in addition to Mr. Kinzie and Mr. Paxton. Henry Engels is president, F. Klamp is vice-president, Mr. Paxton is treasurer as well as manager, and L. A. Bell is secretary. The Board of Directors comprises, besides the president, vice-president, and treasurer, the following: J. F. Humburg, I. J. Truman, Jr., Richard Spreckels, O. G. Traphagen, Geo. T. Cameron, and C. Hedemann.

In conclusion, I may say that within the last month work actually has been started at the upper mine on the driving of an adit at an elevation of 690 ft. below No. 6 level to serve as a new main haulage-way. The portal of the new adit is near the site of the old smelter. The tentative plan is to continue the mine-tracks to the storage-bin at the mill, thereby delivering the ore without transfer directly from the stope-chutes to the mill-bin. This will ultimately do away with the coarse-crushing plant at No. 6 and the aerial tram, with consequent economy. The orebodies being developed on the 7th level, 200 ft. vertically below the 6th, are fully satisfying expectations based on diamond-drilling, and the outlook for the future success of the enterprise is excellent.



Revision of the Mining Law

The Editor:

Sir—The text of the proposed bill to revise, amend, and codify the laws of the United States relating to the location of mining claims on the public domain, and for other purposes, as published in your issue of June 18, should be discussed for the purpose of revealing its effects, if any, upon our mining industry, in case it becomes a law.

Apparently, the text does not show any material changes in the existing mining law except the added clause that provides for the acquisition of large areas of the public domain for the purpose of storing mill-tailing and other like material; and the repealing of the so-called Apex Law with its extra-lateral features, which has always been an eyesore to the mine operator and a boon to the prospector and miner, who take the initiative in the development of mining districts.

During the last score or more of years, there has been acquired a more thorough knowledge of the genesis of ore deposits, their mode of occurrence, and their relation to geologic structure. Possessing this knowledge in connection with our prospecting and mining experience, we should readily distinguish mineralized land from non-mineralized, and the local spots within the former that are likely to prove of commercial importance; and, ordinarily, we would be able to predict the probable future of our mining industry. But here comes a proposed revision of the laws under which our mining industry has flourished, and still flourishes. This proposed revision seems to be perfect in theory, but useless in fact. It embodies the bending of the natural laws to conform to human laws; the existing laws involve the twisting of the human laws to accord with the natural laws.

Before discussing the merits of the proposed law, or its objectionable features, it would be well to ascertain how much of the surface of the earth would be applicable when its provisions become effective; or, to be more explicit, to find out how much there is of the unappropriated public domain that shows on the surface such geologic features as indicate a probable commercial ore deposit below.

This point needs to be emphasized. Then, broadly speaking in reference to the mining industry of the Western States, it is safe to assume that the area of land in the public domain that would be appropriated under the provisions of the proposed bill is negligible as compared with the area of land that has been appropriated under existing or previous mining laws of the United States.

The truth or falsity of this assumption may be shown by the apprehension of the facts pertaining thereto. This may be done (1) by obtaining from the General Land Office an official map showing the extent and situation of the several parts of the public domain, and the extent of the different areas therein designated as mineral land; (2) by obtaining, from the Surveyor General or the Surveyors General of the several Western States, maps showing the relative position and boundaries of all patented mining claims in each mining district within his jurisdiction; and securing a report on the same, made by competent mining engineers; (3) by obtaining, through the U. S. Geological Survey or other reliable source, a map of each mining district, showing the boundaries and relative position of every unpatented mining claim located therein; (4) and, then, segregating the mineralized lands of the public domain into two divisions; the first, to include the unpatented mining claims; and, the second, the unappropriated residue. Then let the Geological Survey or a corps of practical mining engineers report the real and prospective value of the former, and determine how much of the latter, if any, is worthy of a location notice.

The ascertained result of such a wide investigation would remove all doubt and misapprehension as to the truth of the above proposition. This conclusion is supported by actual observations and cumulative investigations; from which we may infer (1) that the primary cause for the general disappearance of the prospector from his chosen field is that the whole of the Cordilleran region from Canada to Mexico has been so thoroughly searched by prospectors, miners, and others, for ore deposits that the possibility of discovering other ore deposits is so remote that a great majority of the prospectors are following other vocations for a livelihood; (2) that the land appropriated under the provisions of existing or previous mining laws contains nearly all of the mineral wealth, and our mining activities hereafter will be practically confined to the operation and the development of existing mines and mining claims.

From the day that the proposed revision becomes a law, as it would not affect existing mining claims as to their extra-lateral rights, it is evident from the above that the present mining laws as interpreted by the courts will continue to dominate the development of our mineral resources; and that the revised law would practically be useless in fact and somewhat crippled in theory.

There is a strong probability that all 'porphyry coppers' have made necessary provisions for the impounding of their tailings, and, the statement "that all the 'porphyry coppers' have been discovered" is well-nigh a

certainty; these, taken together, show that there is little need for large areas of land for the storage of tailings and other residues. But, should it ever be necessary to have large areas of land for storage purposes, an adequate and conveniently situated site, with absolute title, could be secured from individual land-owners with less trouble and expense than it could be appropriated under Section 13 of the proposed revision bill.

In every mining district of any importance there are generally one or more producing mines and several promising prospects or mining claims extending in various directions and clustered around these producers. After this proposed bill becomes a law, many mining claims are likely to be abandoned, to be subsequently re-located under the provisions of the revised law. In some cases, this may require four locations to cover the area of one abandoned claim, in order to have the claims conform to the sub-divisions of the Public Land Survey. In the course of time, most of the mining districts would contain several of these re-located or hybridized mining claims. These hybrids would be scattered throughout the district, and, in general, surrounded by claims located under the existing law. Thus, in every established mining district of importance, we would have two conflicting laws under which to operate and develop our mines and prospects. This shows the impracticability of the proposed revision bill.

J. R. Johnson.

Silver City, New Mexico, July 15.

Efficiency of Labor

The Editor:

Sir—Referring you to that most interesting article by Mr. H. Foster Bain, entitled 'Training for Foreign Exploration', which appeared in a recent issue of your paper, there is one passage that seems to require some explanation. He states:

"One must not conclude that raising wages cheapens production. It only does so when increased efficiency results from the added desire on the part of the men to hold their jobs or when it enables a particular employer to attract better men from others. Generally added efficiency in labor is purchased at an increased cost per unit, just as the added speed of a fast steamer calls for more coal per mile than when driving at a slower rate."

It is true that raising wages does not cheapen production. We have certainly found that, in the past five or six years of constantly increasing wages, the cost of production has also increased, not in proportion to the wage increase but in a greater ratio. This has been largely due to the decrease in the efficiency of labor. Hence, it is generally true that when wage-rates are increased labor efficiency decreases, especially on the straight wage system of employment.

On the other hand, I cannot understand Mr. Bain's point of view in that added efficiency means an increased cost per unit. Labor efficiency may be increased in various ways, by better working and living conditions, improved mining methods, and by certain bonus or contract systems of employment. All of these mean an increase in the total cost of operation, but the unit cost of production is certainly decreased. I do not believe that the comparison of the efficiency of labor with the speed of a steamer was quite properly made. Greater speed may require more coal, but that is about all the additional expense that would be required, and the total cost per mile of operating would probably be decreased.

Just so with a mine. If 500 men produce 1000 tons per day and if by one or all of the means above mentioned the labor efficiency could be so increased that 1500 tons would be the daily output, it is quite obvious that the cost per ton would be decreased.

Jos. A. Norden.

Bingham, Utah, July 15.

'Pryites' and 'Pyrite'

The Editor:

Sir—Referring to your editorial on page 46, of the 'Mining and Scientific Press' of July 9, relative to 'pyrites' and 'pyrite', permit me to suggest that your reduction of the clause to the singular restricts the application of the process solely to the one mineral, pyrite. Of course, it is true that that mineral and sulphur are the ones commonly used, commercially, for the production of sulphur dioxide; but they are not the only ones.

Dana* lists 17 varieties of 'pyrites', among which may be mentioned, 'arsenical' (arsenopyrite), 'cockscomb', or 'white iron' (marcasite), 'copper' (chalcopyrite), 'erubescent' (bornite, or erubescite), 'magnetic' (pyrrhotite), as being the more important, in addition to 'iron pyrites' (which term includes both pyrite and marcasite). All of these will yield SO_2 when roasted in contact with air; and, specifically, they have all (with the possible exception of arsenopyrite) also been utilized to some extent commercially for the production of SO_2, notably marcasite, and chalcopyrite, in addition to pyrite.

I quite appreciate your oft-expressed objections to over indulgence in plurals, but think that in this case the plural is justified and broadens the application.

Walter W. Bradley.
Statistician and Curator,
California State Mining Bureau.

San Francisco, July 11.

['Pyrites' is not the plural of 'pyrite', the *ites* being a Greek termination meaning 'bearing', the word signifying fire-bearing. Therefore it is pronounced pie-rie-tees, not pie-rights. Modern mineralogy has accepted 'ite' as the usual terminal and pyrite has been introduced in compliance with the custom. It has the advantage that it gives a plural, whereas the old term pyrites has no plural form. Yes, there are several kinds of pyrite, but when the word is used alone it signifies the commonest pyrite, namely, iron pyrite; the others are copper pyrite, arsenical pyrite, etc.—Editor.]

*Dana, J. D. (revised by E. S. Dana), 'The System of Mineralogy'; 6th ed., 5th thousand, 1914.

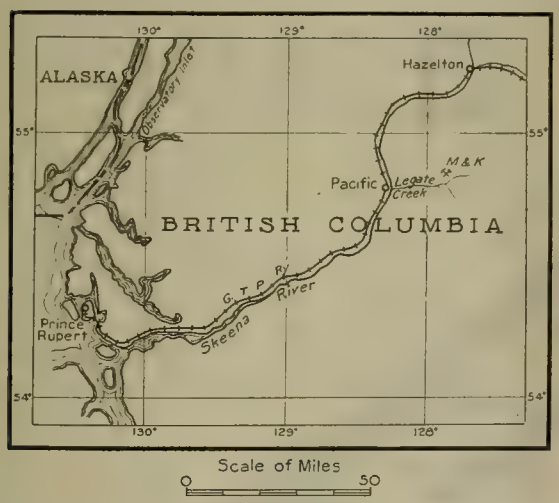
An Unusual Copper-Lead Deposit

By W. L. Uglow

The M. & K. prospect is interesting geologically and mineralogically because of the unusual type of occurrence for this Province and of the remarkable association of copper and lead minerals. The following description is based almost entirely on my field-notes, and is published with the consent of the parties for whom the examination was made.

The property is situated about 15 miles in an easterly direction up Legate creek, which enters the Skeena river one mile west of Pacific on the Grand Trunk Pacific railway. See map. It is reached by a pack-trail leading from the railway directly to the property. The mineral showings extend from an altitude of 4100 ft. up to 4725 ft., along the southern side of the M. & K. ridge, which presents a fairly even slope of about 35°.

The geology of the deposit is simple. The country-rocks consist of a conformable series of lavas and volcanic fragmentals, among which brown amygdaloidal and porphyritic andesite and basalt, greenish-black tuff, and brownish tuff agglomerate are prominent. This series is believed to belong to the Hazelton group. Dikes and sills of quartz-porphyry intrude these rocks, and seem to be responsible for the formation of the ore-minerals.



The bedded volcanic rocks strike almost due north (magnetic) and dip about 35° easterly. This structure controls the topography of the mountain-side, which, therefore, becomes a dip-slope. The mineralized zone occupies a persistent horizon that lies immediately underneath the overburden over the main part of the slope and conforms closely in attitude to the contour of the ground. In an easterly direction this horizon disappears from view under a thick cover of the volcanics (Fig. 2). This zone has been followed and opened up to a slight extent at intervals for an inclined distance of 850 ft. in a southeasterly direction, which on a dip of 35° gives horizontal and vertical dimensions of 700 and 500 ft., respectively. There is no reason to believe that the limits of the mineralization in this direction have been reached.

The deposit is oxidized in places for a few feet below the surface, so that it is difficult to ascertain the average width of the zone, but an estimate of 2.5 to 3 ft. is believed to be safe.

The deposit is a replacement of what appears to be a bed of tuff. The zone of mineralization is composed of two distinct parts: an upper hard silicified portion varying in thickness from eight inches to five feet, carrying disseminated chalcopyrite with some bornite and galena; lying directly on a lower soft mashed portion from a few inches to eight feet thick, consisting chiefly of broken decomposed rock and gouge, and containing angular lenticular and rounded masses of an intimate mixture of bornite, galena, and chalcopyrite. These masses vary in size from that of a walnut to pieces two or three feet in diameter. Below this lower mashed portion is a definite slickensided foot-wall.

FIG. 1. THE PROSPECT

The hard upper portion of the zone seems to be continuous in extent, but not of uniform thickness. The

lower portion containing the solid masses of the sulphides is discontinuous and is found chiefly in depressions in the foot-wall. Between these depressions the hard portion of the zone lies in contact with the smooth foot-wall. See Fig. 3.

The property is developed by 17 small open-cuts on various portions of the dip-slope and by two tunnels on the mineralized zone, about 50 ft. and 8 ft. long. In no case do the open-cuts penetrate the foot-wall, which is rarely more than 8 or 10 ft. below the surface. No work has been done to ascertain the value of the upper hard portion of the zone; all the development has tended to discover and remove the segregations of high-grade material from the depressions in the foot-wall.

The grade of the ore is as follows:

(*a*) Solid Masses of the Lower Zone. Results obtained from

(1) Shipments. In 1916-17 about 125 tons was stripped from two or three of these depressions and sent to San Francisco. This shipment realized a net return of over $100 per ton (silver at 72c., copper at 24c., lead at 4.8c.). The assay was approximately 18 oz. silver per ton, 30% lead, and 18% copper.

(2) Dumps. Over 50 tons of somewhat similar material now lies on various small dumps; and grab-samples from these indicate a metallic content approximately as follows: 3 oz. silver per ton, 11% copper, and 13% lead.

(*b*) Upper Silicified Portion.

Seven channel-samples taken at intervals across this portion gave gross values varying from $6.50 to $60 per ton (silver at 94c., copper at 19c., lead at 9c.). These values are largely accounted for by the copper content.

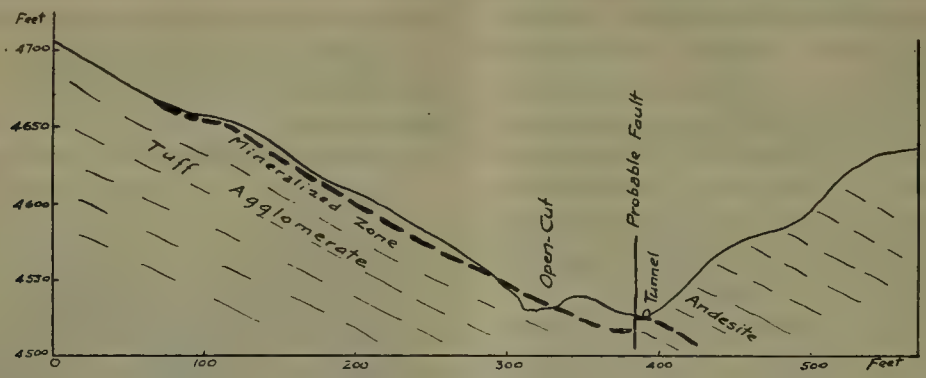


FIG. 2. CROSS-SECTION OF THE M. & K. PROPERTY

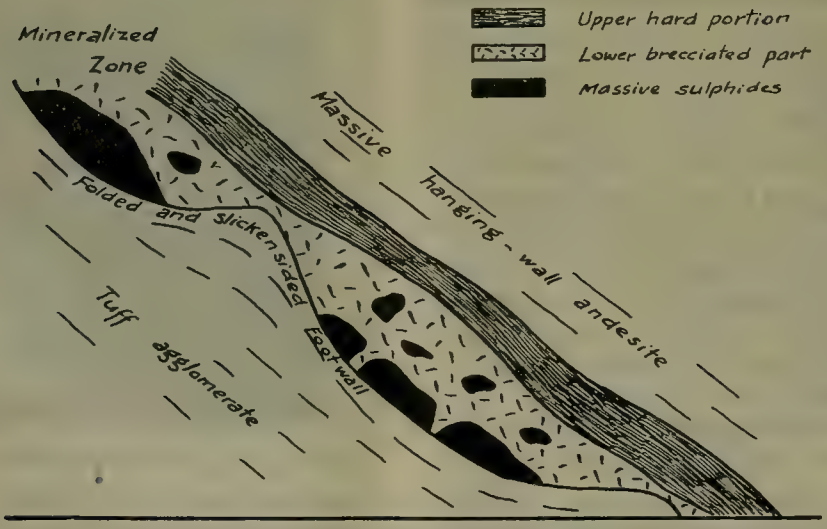


FIG. 3. LONGITUDINAL SECTION SHOWING OCCURRENCE OF M. & K. ORE

The following characteristics of the deposit are of especial interest, and are the reason for the presentation of this paper.

(1) The mineralized zone lies almost immediately beneath the grass-roots over a large part of the dip-slope. It has already been eroded from most of the western portion of the hill-side.

(2) There is little pyrite in the deposit. The chalco-

pyrite in both portions of the zone is of the dense compact type and is comparatively pure.

(3) The mineralogy of both portions of the zone is the same, although chalcopyrite is most abundant in the upper part, and bornite and galena in the lower part. The minerals of the upper portion are disseminated through a gangue of highly silicified rock; while those of the lower portion are in solid masses separated from one another by rotten rock and gouge.

(4) The bornite-galena association. The solid masses of sulphides of the lower portion of the zone occupy the basins of drag-folds between the hard hanging and foot-walls. See Fig. 3. The most persistent characteristic of these masses of sulphides is the intimate association of bornite and galena of a fine-granular structure, indicating simultaneous development. In places, this mixture is almost free of visible chalcopyrite, whereas in other places, veinlets and larger masses of chalcopyrite appear to ramify through the other ore-minerals.

The examination of polished surfaces of this material has revealed the fact that the bornite and galena, with minor amounts of sphalerite, appear to be of simultaneous formation; whereas the chalcopyrite undoubtedly replaces portions of the bornite. Covellite is the latest generation and cuts indiscriminately all of the above-mentioned minerals. Under high magnification the megascopically homogeneous bornite is seen to be filled with a quadrillage structure of chalcopyrite laths, which represent one of the early stages in the process of the replacement of the bornite.*

The origin of these masses of copper and lead sulphides of the lower portion of the zone was not satisfactorily worked out in the time at my disposal in the field, but the following represents the working hypothesis that was used:

Before the folding of the volcanic series into their present attitude, the two portions of the zone of mineralization were fairly uniformly distributed and persistent. The upper portion, being silicified, was competent compared with the lower portion, which probably consisted of bands or elongated masses of the intimately associated bornite, galena, and chalcopyrite, of tabular habit, formed as replacements in a relatively incompetent bed of tuff. This tuff bed is succeeded in depth by a bed of agglomerate. During the deformation, the foot-wall of the mineralized zone or the top of the agglomerate bed was dragged into a series of small folds, while the softer inter-bed was mashed and squeezed and forced to occupy those basins or portions of the lower folded bed, which did not come into actual contact with the hanging wall. During the mashing of the material of the inter-bed, the bands or tabular masses of bornite, galena, and chalcopyrite were brecciated, and are consequently now found as fragments surrounded by the mashed remains of the tuff. See Fig. 3.

This folding and brecciation of the material of the inter-bed left it highly pervious; and in its present attitude it constitutes a collecting channel and zone for the rain-water falling on the hill-slope. The circulation of this meteoric water down this channel has resulted in the oxidation and alteration of portions of the sulphides. In places solid masses of malachite and azurite with limonite are found enclosing remnants of the sulphides, while ramifying through the dense mass of sulphides are narrow veinlets of covellite, evidently of meteoric origin. The almost complete absence of chalcocite of similar meteoric origin is a noteworthy feature.

*A paper taking up the description and origin of this quadrillage structure will appear in the January 1922 issue of the 'American Mineralogist'.

IMMERSION in boiling water reduces the strength of concrete, regardless of age, of the duration of the period of such immersion (except long immersions of very 'green' specimens), or the temperature of drying, so long as this does not exceed 180°C. These conclusions were reached by W. J. Schlick, of the Engineering Experiment Station of the Iowa State College of Agriculture and Mechanic Arts. Tests indicate that oven-drying generally causes a slight reduction in strength, but that this effect is so much less than that due to immersion in boiling water as to be obscured almost wholly when the specimen is subjected to both treatments. These tests show that immersion in boiling water causes a greater reduction in 'green' concrete than in well-cured concrete, and that a long-time immersion in boiling water hastens the strengthening of concrete. They also indicate that this loss in strength is accompanied by a loss or gain in weight, depending upon whether or not the concrete is oven-dried before the immersion. As there is no apparent physical action which could produce any of these effects in the amount shown by these tests, it seems logical to conclude that their basic cause is chemical action, which is accompanied by physical changes. It is known that the hydration of cement is accelerated by moisture and heat, and that not all of the cement is hydrated under normal curing conditions. On the basis of these facts it seems possible that the loss in strength due to immersion in boiling water is due to a rapid hydration, or curing, of cement not previously hydrated; and that this furthered and accelerated hydrating action is accompanied by changes in volume which tend to break down the more or less rigid structure resulting from the earlier hydration. The results with 'green' specimens that were immersed in boiling water for long periods seem to bear out this explanation. All the specimens tested, both tile and laboratory specimens, except tile of three series of the Bureau of Standards tile, were made with cements commonly used in Iowa, and probably similar in composition. Because of this fact, these data do not show what the effects might have been had other cements been used, or the qualities of the cement which will cause these effects to be the largest. As stated previously, these tests were made primarily to determine the effects of different immersion and drying treatments in connection with tests of concrete drain tile. The results show that no specimen should be subjected to any test in which its strength is a factor, after it has been immersed in boiling water.

Metal Mining in California

By Charles G. Yale, of the U. S. Geological Survey

Metal mining in California during the first half of 1921 has been even more depressed than in 1920. Owing to the low prices of most of the metals and the increasing cost of production many mines have shut-down and others have reduced operations. During the first six months of 1921 the United States Mint at San Francisco and local smelters and refiners received from the mines of the State $7,362,294 in gold, or $482,000 less than during the first six months of 1920, when the receipts were $1,086,739 less than in 1919.

The silver received during the first half of 1921 by the mint, smelters, and refineries amounted to 1,235,820 oz., or 726,535 oz. more than in the first half of 1920, and the first half of 1920 showed an increase of 376,310 oz. over the same period in 1919. This is somewhat remarkable, for several of the large copper mines of the State, from which most of the silver produced in California has usually been derived, have remained closed in 1920 and 1921. The deficiency thus caused has been more than made up during the last two years by the silver and silver-lead mines, more of which have been producing than in the preceding 25 years or more. Most of these mines are in Inyo and San Bernardino counties. By far the largest producer of silver in the State is the Rand, in San Bernardino county, opened in 1919.

No signs of immediate improvement in gold mining in California can be seen. The cost of supplies has diminished somewhat, but wages continue to be a source of contention between the operators and the miners' unions. Within a few weeks two of the most productive deep mines of the State will probably be added to the number that are closed down. At one of the larger mines, which crushed more than 60,000 tons of ore last year, the cost of producing gold was $19.15 per ounce, and this property has perhaps the best-equipped reduction plant in California, making a total recovery of 97½%. The decrease in output does not affect equally the deep and the placer mines. The output of the deep mines appears to be falling off about 16%, whereas that of the placers is falling off only 12%. The placer-gold output is kept up mainly by the dredges, which show little total loss, but other forms of placer mining are not so prosperous as formerly.

Unfavorable conditions exist not only at the gold mines but at those yielding copper and other metals. Most of the larger copper mines and nearly all the smaller ones are still closed down, as they were in 1920. The most productive counties are Plumas, Calaveras, and Shasta, in the order named. The largest producer in the State is the Engels mine, in Plumas county, which continues its large production in the face of adverse conditions. There has been an increase in the output of both lead and zinc, due almost entirely to the mines in Inyo county, although some zinc comes from Shasta county.

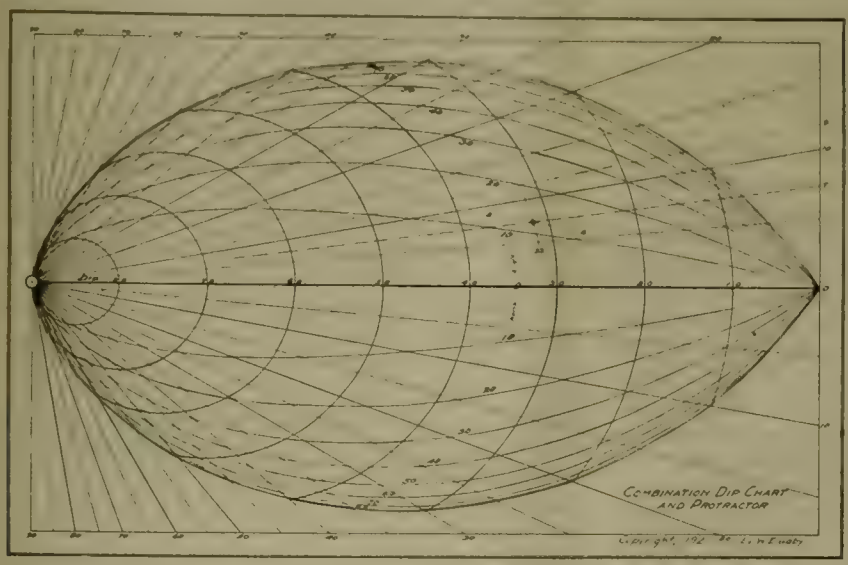
The Butte & Superior Mining Co., of Butte, has acquired interests in the Shasta Zinc & Copper Co., at Winthrop, Shasta county, and has also bought the property of the Bully Hill mines. The experimental zinc-oxide plant of the Shasta company began operations in April. The Argonaut mine, at Jackson, Amador county, one of the big Mother Lode mines, which was pumped out after the fire and flooding, is again producing, but its neighbor, the Kennedy, remains idle. The Utica and Gold Cliff mines, at Angels, Calaveras county, after more than half a century of productiveness, have been closed down permanently and allowed to fill with water. The old Plumas-Eureka mine, at Johnsville, Plumas county, has resumed operations, and the Rainbow, at Allegheny, Sierra county, is to be re-opened. The Fremont Consolidated, at Amador City, Amador county, closed for several years, is being pumped out for exploration. The famous old Rawhide, at Jamestown, Tuolumne county, is being re-opened, and a new 1800-ft. shaft is planned for it. A new 10-stamp mill is being erected for the Kate Hardy, at Forest City, Sierra county, and another of the same capacity has been finished at the Finnigan mine, at Angels, Calaveras county. A mill is also being built on the Grit property, at Spanish Dry Diggins, near Greenwood, El Dorado county. The Virginia-Belmont Co. has resumed development on the Virginia mine, Coulterville, Mariposa county, formerly owned by the White Gulch Mining Co. The Ghost mine, on Railroad Flat, Calaveras county, is being re-opened. A new 100-stamp mill is under construction at the Cerro Gordo mine, in Inyo county. The Juniper mine, Hayden Hill, Lassen county, which was re-opened after a long idleness, has been running its mill steadily since February. The Blue Ledge copper mine, in the mountains of Siskiyou county, near the Oregon line, which has been producing copper without interruption since the War, has closed down, and the construction of the proposed $50,000 electric power-plant has been indefinitely postponed.

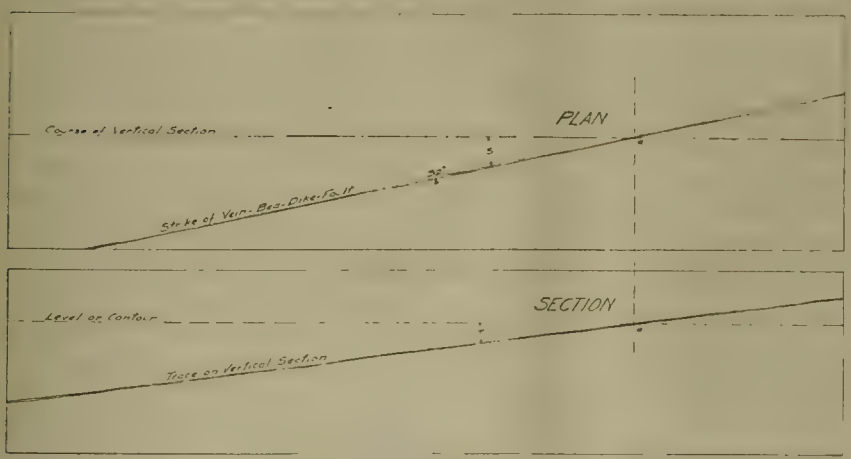
The reminiscences of old miners as well as reports, official and other, of remains of the great bonanza in the bottom of the old Eureka or Hetty Green mine, at Sutter Creek, Amador county, idle for a great many years, induced certain prominent capitalists to pump-out and re-open the mine. After a year or two of work, pumping, sinking shafts, running drifts and cross-cuts, and extensive diamond-drilling in all directions, with the expenditure of about a million dollars, nothing of value was found, and the enterprise has been abandoned.

Combination Dip-Chart and Protractor

By W. E. Gaby

The form of dip-chart shown herewith was evolved for the purpose of preparing vertical geologic sections with ease and rapidity; its convenience has been amply demonstrated. It has a number of advantages over the usual logarithmic form of dip-chart, chief of which are the reduction and simplification of drafting operations.





In this form of chart two systems of curves, superimposed upon protractor, form co-ordinate lines by means of which one may pick a point on the protractor that will determine the angle of apparent dip of a vein, or other geologic structure, upon a given vertical section. The co-ordinate lines are drawn for intervals of ten degrees, from which the lines for odd degrees may be interpolated. The real dips are registered on the circumference of ellipses tangent at the centre of the protractor. The horizontal angle between the strike of the vein and the course of the vertical section is registered on a curve interpolated from those that extend from end to end of the centre or zero line of the chart.

In the illustrative solution, the curve for a horizontal angle of S (or 12°), intersecting the ellipse for the real dip, 32°, gives the point which determines the apparent dip as T degrees (7° + in this case). But if the chart, the geologic plan or notes, and the section are all oriented with respect to each other as shown, the operations of plottings can be made with no other instruments than a pencil and parallel ruler. So arranged, a line through centre of protractor carried parallel to the strike of vein gives the horizontal angle with the section. The value of this angle is noted. Then, in combination with the angle of real dip of the vein, one finds the point of intersection of the corresponding curves on the chart. The edge of the rule is then placed on the line between this point and the centre of the protractor, which line, carried parallel into the section, gives the apparent dip required, or, in other words, the trace of the vein on the section. The latter operation obviates the necessity of reading this angle at all, or of using a separate protractor to plot it.

In entering the chart, one must choose the side (upper or lower) that will resolve the apparent dip in its proper direction. The chart is more nearly precise for low angles, but it is sufficiently accurate in all ranges for geologic correlations; when either real dip or horizontal angle approaches 90° the variation of the apparent dip is small.

GRAPHITE is found in Ceylon in greater abundance than in any similar area in the world, states a consular report. The soil and rocks are almost everywhere impregnated with graphite, so that it may be seen covering the surface in the drains after rain. The supply is practically inexhaustible. Ceylon graphite is remarkably pure. The principal mines in Chosen, Korea, are in North Pyengan, North and South Choo-Chung, North Kyungsang, Kwangwon, and South Hamkyung provinces. Graphite is found in Hunan, China, on the Upper Mekong; it also exists near Wenchow (Chekiang), and in Kwangtung, in Kaotzu, west of Chingkiang in Kiangsu.

Future of Mining in Alaska

By Alfred H. Brooks

*The Alaskan mining industry, which has turned out products having a total value of $438,160,000, began in 1880 with the recovery of some $20,000 worth of gold from placers near Juneau. Of this total value, 96% is to be credited to the gold and copper deposits, but Alaskan mines have also produced silver, platinum, palladium, tin, lead, antimony, tungsten, chromite, coal, petroleum, marble, gypsum, graphite, and barite; development work has been done on deposits carrying nickel, iron, molybdenite, and sulphur.

The exploitation of Alaska's mineral wealth before the War showed a steady growth, with some fluctuations from year to year, such as are more or less inherent to mining in remote regions. This advance was made in spite of the handicaps imposed by isolation, the inadequacy of means of communication, and the long existing interdict on the development of the coal- and oil-fields. Then came the change of industrial conditions wrought by the War. Its first effect was to increase Alaska's output of copper; this increase in 1916 brought the value of the total mineral output of Alaska up to over $48,632,000, a larger amount than that for any other year since mining began. The decline in price and market demand for copper since 1916 and the world-wide depression of the gold-mining industry has greatly affected Alaska. As a consequence the value of the total mineral output of the Territory in 1919 was only $19,621,000, as compared with $28,254,000 in 1918.

This marked decline has been noted with alarm by many who are interested in the Territory and has been especially disconcerting to the general public, because it came at a time when Government funds were being expended on a railroad intended primarily to open up the mineral resources of the interior. This decline is not due primarily to local causes, however, but is largely the result of world-wide industrial conditions brought on both by the War and by the readjustments that have followed it. It is pertinent to inquire what the future holds forth for Alaska mining. If it is true that the decline in output is due to the general instability of industrial conditions, recovery must await the improvement of these conditions.

Although many local factors affect the future of the Alaskan mining industry, the most important consists of the mineral reserves. Unless the accessible reserves are large enough to support a future growth, the mining industry, no matter how favorable may be the conditions of exploitation, will languish. Those who have inquired about the quantity of mineral reserves have usually received the stereotyped answer that Alaska has vast stores of mineral wealth awaiting development. However true this may be, the public has a right to know on what facts such statements are based. An attempt will be made here to summarize briefly these facts, and to forecast, so far as may be, the future of Alaska as a producer of minerals.

Before considering the future of the mining industry, it will be desirable to examine briefly the record of the past. The statistics of mineral production for the last 40 years are given in a later section of the report. Curves, though recording fluctuations from year to year, show on the average a uniform growth of output until the outbreak of the War in 1914, since when Alaska's mining industry has been unstable. If the pre-war curve showing the value of Alaska's total mineral output is projected over the last five years, it will indicate that under normal conditions the value would have been about $22,000,000 in 1919. It is significant that the actual value of the output in 1919 ($19,621,000) was only about 10% below this normal value indicated by the curve. This in itself is very encouraging, for it indicates that the Alaskan mines are on an average nearly holding their own, in spite of the present adverse conditions.

The pre-war curves might, of course, be projected also into the future, with a view to thus obtaining a rough estimate of the probable developments of the Alaskan mines. Such an estimate would have little value, however, because the mineral output of the past does not indicate the changes that will be brought about by the construction of the railroad and wagon roads, the reduction in freight charges, and the opening of the oil- and coal-fields. Moreover, such an estimate would assume, without proof, that Alaska's mineral reserves are ample to support a growth of the mining industry in the future at the same rate as that of the past. The quantity of the several minerals occurring in Alaska is evidently the significant element in the problem. In discussing these reserves it will be desirable to limit the estimate to those which are now or can soon be made available.

An estimate of Alaska's mineral reserves would be difficult enough even with complete geologic maps of the entire Territory. Only about 20% of Alaska has been covered by even reconnaissance geologic surveys, and less than 1% by detailed surveys. This meagreness of geologic data is in a measure offset by the fact that the area surveyed covers much of the immediately accessible parts of the Territory, where the most extensive mining developments of the near future are to be expected. The information at hand, however, at best does not permit quantitative estimates of reserves. Nevertheless, it indicates the areal distribution of the mineral deposits, and a study of their geologic occurrence gives a basis of forecasting their availability to the miner. These data, considered in connection with the accessibility of the deposits and the probable market for their output, will afford a rough measure of their availability in the near future. The production of placer gold has been founded principally on bonanza mining; lode mining has been supported chiefly by the large-scale exploitation of low-grade ores. The tendency of bonanza mining has been to cause considerable fluctuations in the annual gold output, but these fluctuations have, in a measure, been offset by the steady production of the large Juneau mines.

*Abstracted from Bulletin 714-A, U. S. Geological Survey.

Book Reviews

Writing English Prose. By William Tenney Brewster. 16vo. Pp 260. Published by Henry Holt & Co., New York. Price, $0.90.

This is another aid to the correct writing of our language. The author is Professor of English in Columbia University; he writes therefore not only as one having authority but as a practised teacher of the subject. It is a winning little book; at least, I found it so; for the opening sentence did not please me at all and in the first chapter I found several departures from good writing; yet I continued to read, marking fewer and fewer passages to which I could take exception, until I finished the last page regretfully. A writer on 'writing' is subject to severe criticism, inevitably, and the reviewer of a book on such a subject is likely to be on the alert for blunders and infelicities of expression, but those for whom such a book is chiefly intended will approach it in a less exacting spirit and therefore miss some of the minor faults to which I have alluded. Some of them are due to the author's desire to avoid an excess of the pedagogic pose by descending to the use of colloquialisms or by lightening his admonitions with a touch of humor. These may detract from his style; but, after all, they are consistent with the fundamental rule of writing as he lays it down: "to write with your eye on the object", which some of us will change readily into the familiar admonition, "keep your eye on the ball". Professor Brewster says: "The great questions likely to be applied by anybody, at any time, to any piece of writing are these: 'Does it say what is intended?' 'Is it intelligible?' 'Is it said in as interesting and as agreeable a manner as is possible or necessary?' " The book stands this test: it is both interesting and agreeable. The author proceeds to say: "Writing, like talking, is nearly always directed to particular people or groups of people, to the end that they maye be informed, or enlightened, or interested, or persuaded." In short, the fundamental rule of effective writing is 'Remember the reader'.

The first chapter discusses the principles of composition. "An inherent condition for expression in any language is progression. . . Meaning is conveyed by a series of approximations; and, whether we think about the matter or not, we are, in all literary composition, bound to be progressives." A capital would have emphasized his point, for if he did not refer to the 'Progressives' he could have used the singular more satisfactorily. The idea of progression is a good one, "of progression from word to word, from sentence to sentence, from paragraph to paragraph". He expatiates on it most usefully in this chapter, which is rich in valuable advice. "The great condition of all communication, written or spoken, is intelligibility. . . It is also a condition of communication that we put a good foot forward, that, in short, we try to be as interesting as possible. . . Unless a writer conforms to the conditions of knowing his facts, his own mind, or what he wishes to say, he is likely to fall into all kinds of vagueness, obscurity, and error." Presumably the Professor deemed it pedantic to use the subjunctive after "unless"? "Clearness is, in a sense, truth. . . Even if our ideas come pell-mell, they have to be recast for human consumption; otherwise we may get intellectual indigestion or spiritual strangulation. . . Ideas do, as a matter of fact, spring from one another, are associated with and suggested by one another; a natural condition of working is to follow their lead." That is why so much writing is bad: it is disorderly simply because the writer fails to develop his ideas logically. "Any specific act of writing usually is the threefold process of planning, writing, and revision." Many writers omit the first stage and consider the third unnecessary; hence the need for editing, of which there is not nearly enough, in books as well as in periodicals.

The author lays stress on 'conditions' rather than 'laws'. He favors freedom of movement and is impatient with set rules of composition. "A writer is limited, not by rules, laws, and precepts of writing and of style, but by conditions; that is, as we have seen, by his ideas, his audience, and the character of the language. The more he knows about these the better he will write." Yes, indeed, but the so-called 'laws' of composition are like the conventional plays of whist, in so far as they are the outcome of long experience; it is well to observe them, after having ascertained the purpose of them. To attempt to write or to play whist by rule without a thorough understanding of the rules is to court disaster; it is stupid. The author says: "The so-called principles of composition are useful only because they are sometimes conveniences of a more general sort. . . The present tendency is, however, to use the word 'principle' in a technical rather than a moral sense. Thus unity, coherence, and emphasis are the group names for certain specific points that you may well keep your eyes open for when you read or write." A whist-player may have been born with card sense, and that innate ability would enable him to arrive intuitively at the correct plays, whereas one less fortunate in that regard would find it of great help to himself to be told the conventional rules; so an inexperienced writer, and one deficient in an innate ability to write, may be greatly assisted by being given a few 'rules' or 'principles' by which to guide his efforts to express himself intelligently and pleasantly. One of these is to avoid entanglement with prepositions, such as the "for" after "eyes open" in the preceding quotation.

At the beginning of his next chapter the author again develops his idea of progression: "Composition in literature is simply the art or the act of arranging the facts to be expressed in such a way as to bring out what is important; its object is to make clear or impressive the point or effect of any piece of writing. Order is, as we have seen, fundamental to good composition; but whatever may serve to make meaning clearer, to throw important facts into greater relief or to make them more interesting, belongs to the subject. In any event, literary composition, whether simple or intricate, depends on the structure of language; that is to say, it is essentially a method of progression, of accumulation, of piecing out idea with idea, of adding fact to fact."

In order to comply with "the inherent condition of all writing" it is necessary to examine the various ways of progression. There is time. Things happen in succession. Next comes cause and effect, the one necessarily coming after the other. Many things are "related to each other by position. . . There are recurrent facts, and the recurrence may be in uniform order. . . A certain state or condition is the result of antecedent situations and conditions and will lead to further conditions, so that our progression may take the form of looking back to a previous condition or looking forward by way of prophecy." The author elaborates this basic idea further, thus: "Two interesting types of progression—further refinements, if you will, on the main types—may be called composition by thesis and composition by prevailing mood. So far as these methods differ from the preceding it is in this: that not all the facts in a subject or a large or small body of interesting facts are ranged one after another, until the facts as facts are sufficiently aired, but that specially selected facts are made to illustrate and enforce special ideas and modes. On the central idea the facts are, so to speak, strung in the most effective and enticing order."

He gives a nice rhetorical touch to all this by concluding: "Structurally the thesis is the fork or spit which toasts the facts before the fire of genius." Coming to earth again, he repeats: "The process of composition is (1) a matter of classification of facts and (2) the ensuing arrangement of groups or divisions in the most effective order".

Good composition calls for unity, coherence, and emphasis. "The best way to gain unity," says the author, "is not to think about it, but to think of a subject till you know what you think and wish to say about it; and having done thus, to adopt as uniform a basis of treatment as may be, with due regard to the frailty of the reader." Yes, with constant regard for the reader, whether he be frail or robust. Coherence is "another way of saying that the facts in a piece of writing must be intelligently classified". Professor Brewster recognizes that Huxley was "a master of expository method" and instances the lecture on 'A Piece of Chalk', which is a fine model indeed for scientific writers. Emphasis in composition, he proceeds to say, requires "that important ideas shall be given important treatment". Referring to Stevenson's writings, he says: "The application of the so-called principles of composition is here obvious: unity means a careful selection of material and the removal of all husks that would clog movement; coherence, an arrangement of plot with as few hitches as possible; emphasis, elevating of important and the slighting of irrevelant matter."

A chapter is given to 'Narration, Description, and Exposition'; another to 'Argumentation'; and another to 'Paragraphs'. Each of these contains many valuable hints. The author is averse from positive dicta, however. For example: "We may say that there should be order in the sequence of ideas and sentences; that a paragraph may not unreasonably fulfil, in some way, the promise of its topic; that it is sometimes convenient to balance one part of a paragraph against another by a series of antithetical sentences, as frequently in Johnson, or by a formal opposition of beginning and ending, as sometimes in Macaulay, or by a topic set in opposition to the rest of the paragraph, as with many of our modern paradoxical writers who are masters of the formula, 'It is usually thought—But the truth is'. Everything depends on what one has to say, but, under that restriction and so long as there is some kind of order, any one of many arrangements may be about as good as another." Next we come to 'Style', to which five chapters are devoted under the sub-headings of 'Sentences and Words', 'Correctness', 'Economy and Increment', 'Pure Movement', and 'Composition'. He treats this part of the subject, as he does the remainder, in a businesslike way, without rhetorical confectionery. Style of writing to him is merely "manner of writing". He adds: "Over and above intelligibility, which is the natural aim of all language, style, as a special result, is conceived to be an expression of personality, of individuality, of 'the writer's sense of fact' ". To teach style, therefore, is impossible. "It is as idle to give instruction in the art of expressing individuality, of being oneself, of joining the chosen band of the naturally gifted, as it would be to attempt to teach youth how to become self-made men." He gives many examples and analyzes them carefully. He mentions reading aloud as the test of good movement in prose. Undoubtedly it is a good test not only of the quality he mentions but of writing in general, and it is one that the student should not fail to employ for the betterment of his method. In the last chapter, on 'Methods and Applications', after discussing the methods of sundry famous writers, we find this conclusion: "Practice is evidently very diverse; the only really constant thing is apparently that most writers of eminence have, at some or all points in their career, felt the necessity of taking pains". I venture to emphasize the last four words, for in them is the sum of the matter. Genius is said to be "an infinite capacity for taking pains". Another definition says that genius is one part inspiration and nine parts perspiration. Good writing comes from innate talent cultivated by patient practice. I have quoted enough from this book to indicate its style and character. Professor Brewster has produced a useful book. It may lack literary charm, for that is rare in the treatment of such a subject; and his own writing may not be impeccable, for that is human; but the book fulfills its purpose as a friend to those who desire to improve their own writing or to teach the difficult art to others.—T. A. R.

Recent Practice in the Use of Self-Contained Breathing Apparatus. By Rex C. Smart. J. B. Lippincott Co., Philadelphia. Pp. 242, ill. For sale by 'Mining and Scientific Press'. Price, $6.50.

The author, who during the Great War was the officer in charge of the First Army Mine Rescue School of the British Expeditionary Force, takes advantage of the experiences gained in training men and in organizing companies for mine-rescue work; he shows, with the extension of mining operations on the Western front, the depth to which mining was carried out, and, considering the large amount of explosives used, the necessity for the employment of mine-rescue apparatus. Plans of mine galleries that are reproduced will give an idea of the extent of underground work. With the organization of mine-rescue work, greater protection was afforded to the personnel of mining units; lives were saved, and gas poisoning was greatly reduced. The book is sub-divided into the following subjects: I. Organization of Mine-Rescue Schools. II. Training of Personnel of Mining Companies. III. Self-Contained Breathing Apparatus. IV. Testing and Repairing of Apparatus. V. Formation of Characteristic Mine Gases in Military Mining. VI. Resuscitation From Mine-Gas Poisoning. VII. Organization of Mining Companies in Mine-Rescue Work. VIII. Rescue and Recovery Work in the Trenches. IX. Use of Breathing Apparatus in Mine Warfare. X. Care of Mice and Canaries. Bibliography. Index.

The Location, Grading and Drainage of Highways. By Wilson G. Harger. New York, McGraw-Hill Book Co., Inc. 294 pp., 6 by 9 in., 134 illustrations. For sale by 'Mining and Scientific Press'. Price, $3.50.

The author, who was formerly the senior highway engineer, U. S. Office of Roads, discusses the general principles that should govern the policies of highway engineering. The book considers a suitable system, appropriations, estimates, principles of design, and other pertinent matters. The questions of economic location and grade-line design are developed from the standpoint of horse- as well as motor-traffic. The treatise is the first of a series of four volumes on the subject; other volumes will deal with the selection of type of pavement, methods of construction and re-construction, and detail methods of field and office work. The contents of the present volume are: I. General principles of highway design. II. Proportion and economy in design. III. Classification, route and general engineering location. IV. Grades and alignment. V. Cross sections of rural roads; widths of pavements; right-of-way clearing. VI. Drainage; appendix; highway bonds.

Field Mapping for the Oil Geologist. By C. A. Warner. John Wiley & Sons, Inc., New York. 146 pp., ill. For sale by 'Mining and Scientific Press'. Price, $2.50

In the preparation of this book it has been the author's aim to furnish a handbook of field methods that would be of value to those geologists who have had little experience with the methods commonly employed in examining a territory not yet drilled. Only the important phases of field mapping have been considered. The reader is given a general résumé of the more important principles, with the idea that a foundation may be laid upon which detail work can be added. The book is divided into five chapters with the following headings: Study of Field Conditions; Maps, Their Value and Interpretation; Field Mapping and Methods; Field-Mapping Instruments, Their Use and Adjustment; Useful Tables and Meridian Determination.

HAYDEN BILL ON CLAIM ASSESSMENT WORK PASSES HOUSE AT WASHINGTON

The House of Representatives has passed the bill, introduced by Representative Carl Hayden of Arizona, providing that the 'assessment' year for unpatented mining claims shall begin and end at 12 o'clock noon on July 1. Indications are that the bill will pass the Senate at an early date. This has no bearing upon the work for the year 1920, which became delinquent if not started before July 1, 1921. The new bill applies only to the future.

COPPER AND BRASS RESEARCH ASSOCIATION IS ORGANIZED

The Copper & Brass Research Association, a voluntary unincorporated body, has been organized in New York by producers of copper and fabricators of copper and brass. A campaign has been initiated to obtain as many members as possible. W. S. Eckert, secretary, in a communication sent to copper companies and others who may be interested, says: "With the copper-producing industry highly developed, we have not yet realized the full benefits from such development, for effort has heretofore been directed to the advancement of the individual without exploiting the wonderful properties of copper. Business conditions now prevailing, with the centralized control of the merchandising of many of the materials in competition with copper and its products, makes apparent the absence of concerted action by the copper and brass industry to win the ultimate consumer. And in reaching the ultimate consumer we have a problem too great for any individual member to solve; in its solution, through a united effort, each producer and fabricator will benefit."

NEW BILL ON WAR MINERALS RELIEF

John E. Raker, Representative from California, has introduced a bill before Congress to extend the provisions of the War Minerals Relief Act, incorporating practically all the amendments to the original bill which are understood to have received the approval of the Interior Department. Mr. Raker's bill extends the original act for the benefit of claimants whose cases have been disavowed through minor filing discrepancies. Additional authority is granted the Secretary of the Interior in the matter of reconsideration of claims upon which awards have already been made, and the unexpended balance of the commission's appropriation is continued available.

EXPORTS OF MEXICAN PETROLEUM DECLINE 80%

In the first two weeks of July there was exported from Mexico 1,645,000 bbl. of oil. This is at the rate of 3,300,000 for the entire month and compares with actual exports in June of 17,600,000 bbl., a reduction of 14,300,000 bbl. In short, based on figures of actual exports in the first half of July exports for the current month will show a reduction of over 80% compared with June. In all probability, too, the final figures for this month will not measure up to 3,300,000, for during the first four or five days of each month there is always a surplus of oil from the preceding month which it was impossible to get out. This reduction is due in part to the export tax imposed by the Obregon government, and in part to the large surplus stocks in the United States.

THREE NEW GOLD-DREDGES TO BE BUILT AT MARYSVILLE, CALIFORNIA

Announcement that the Yuba Manufacturing Co. has secured contracts for the building of three gold-dredges with an aggregate value of more than $1,000,000, was made at Marysville, California, on July 30, by Newton Cleveland, manager for the company. One of the dredges will be built for a company operating on the Tuolumne river. The others will go to Idaho and Colorado. "Securing of these contracts will mean much for the community," said Cleveland. "We shall employ immediately from 150 to 200 men and keep them busy for more than a year."

U. S. SMELTING CO. RESUMES MINING AT EUREKA, UTAH

Operations have been resumed by the United States Smelting, Refining & Mining Co. at its Centennial-Eureka and Bullion-Beck mines at Eureka in the Tintic district, of Utah. These properties are among the oldest producers in this district. For many years the Centennial-Eureka was the largest producer in camp, and the Bullion-Beck has been a consistent shipper since the early days. When the properties closed down early this year, 70 men were thrown out of employment, and it is expected that this number will again be on the payroll within a short time.

COMMISSIONER BELLOWS MAKES A PLAIN STATEMENT REGARDING GEORGE GRAHAM RICE

The following statement, signed by E. C. Bellows, Commissioner of Corporations for California, appears in the latest regular Bulletin issued by the Commission:

"Jacob S. Herzig, better known as George Graham Rice, has been heralded from the Atlantic to the Pacific seaboard as a stock gambler, a crook, a thief, and a jail-bird. Having failed to secure a license from the Commissioner of Corporations of this State, he floated Broken Hills mining stock through the San Francisco Exchange, leaving among the working people of this State, a trail of woe and distress as he headed for Utah to work new fields.

"In Utah he was the active spirit in financing the Bingham Galena Mining Co., and through Child, Barclay & Co., began circularizing his former victims in this State in behalf of Bingham Galena stock, which he claimed would recoup their former losses. In offering this stock for sale here without a permit from E. C. Bellows, Commissioner of Corporations, both Rice and Child, Barclay & Co. violated the Corporate Securities Act of this State, and if they desire to test the virtue of this Act, they have only to place themselves within the jurisdiction of the California courts where warrants await them.

"As was expected, the Utah Securities Commission has attempted to white-wash these offenders, but as far as the California public is concerned the effort will be unavailing. Any stock proposition polluted by the touch of George Graham Rice and his associates will be regarded with grave

suspicion in California. It has been stated that nothing was ever created in vain, but California investors incline to the opinion that the hand of Providence slipped a cog when George Graham Rice put in an appearance."

ARIZONA

Ajo.—The New Cornelia company is working two steam-shovels, employing 300 men, and treating 2400 tons of ore daily, six days per week. Production is running at the rate of about 1,300,000 lb. per month. It is expected that by 1923 New Cornelia will have a capacity for treating 10,000 tons of ore daily, as it is hoped to have the 5000-ton concentrator in operation by that time. This would result in a yearly production of at least 90,000,000 lb. of copper. The positive ore-reserves developed in the property amount to 8,641,000 tons of carbonates averaging 1.44% copper and 46,000,000 tons of sulphides averaging 1.53% copper. These reserves were determined by sinking 160 diamond-drill holes at 200-ft. intervals and to an average depth of 360 ft. Of this number, 27 were stopped in ore of commercial grade. In order to ascertain the results to be expected from the treatment of its large tonnage of sulphide ores (which do not respond to the leaching process) the company erected a 500-ton experimental oil-flotation concentrator which it operated for six months with satisfactory results. A shaft was sunk to a depth of 250 ft. and the sulphide body cut to provide representative ore for this plant. During its operation a total of about 25,000 tons of 1.3% ore was treated, with an average recovery of 85%.

Tombstone.—A report of uncovering larger and additional rich orebodies with high content in copper and silver was brought here recently by John W. Prout, Jr., superintendent for the Central Copper Co., of Mascot. The ore, found on both the north and south side of the hill, runs from 5½ to 20% copper and 16 to 19 oz. in silver. The extent of the ore-shoot has not yet been determined.

ARKANSAS

Yellville.—R. P. Templin, of Alton, Illinois, has purchased the mill equipment and leases on the Dixie Girl property in the Boat Creek district. The plant is among the most modern and complete in the Arkansas fields; it includes tramways for conveying the ore from the mine to the mills, which have a capacity of 150 tons. The property represents an investment of $60,000. Tunnels into the mountain have disclosed an orebody 600 ft. in extent, most of which is high-grade carbonate ore averaging 40% zinc.

CALIFORNIA

Allegheny.—The Tightner and Sixteen-to-One mines are being operated on a two-shift basis, and the stamp-mills are operating regularly on medium-grade ore.——R. G. Gillespie and associates, of Pittsburgh, Pennsylvania, have purchased new machinery, preparatory to development of the Osceola property.——Work on a small scale is being done at the Rainbow, Mariposa, Morning Glory, Irwin, and a dozen other prospects.

Colfax.—J. Boggs, mine superintendent for a company that has leased the old Sim Jordan property, is ready to commence placer operations. The plans of the company are to divert the course of the American river for about a mile by the construction of a rock-bed tunnel, 6 by 7 ft. and about 1500 ft. long. In this manner the sand and gravel in the dry river-bed can be mined without interference from water.

Grass Valley.—The Gold Lead Placer Mines Co. reports that it has entered the channel with a raise 130 ft. from the adit-level. During the last nine months the company has driven 900 ft. of adit and has driven two raises to a total height of 260 feet.

Merced.—Creditors of the Yankee Hill Gold Dredging Co., recently adjudged bankrupt, will meet to determine the disposition of their claims. The assets are a dredge costing $100,000, and tools and equipment costing $25,000. A flood last winter swept the dredge several miles down the river, and it is doubtful whether it has any considerable value other than for junk.

Oroville.—C. A. Miller, of the Foundation Co. of New York, expects to commence operations at Hartman's Bar above Cascade, on the middle fork of the Feather river. The company has completed a dam 137 ft. long, the water from which will generate 180 hp. The water will be pumped out and the gravel will then be handled by a clam-shell bucket.

Placerville.—With the starting of the new 40-stamp mill last week the old Havilla gold property near Nashville has resumed production. The mill is stated by the company officials to be one of the most modern in California. A large tonnage of good ore is ready for the stamps. The Havilla formerly ranked among the premier producers of the Mother Lode.

Winthrop.—J. R. Hall, supervisor of the Shasta National Forest, states that the fume from the new plant of the Shasta Zinc & Copper Co. has already had a noticeable effect upon the vegetation in the vicinity of the plant. It is claimed by the management of the smelter that any damage done to vegetation and gardens was due to hot weather and not to smelter fume. The fume is arrested in bag-houses, and no solid matter leaves the plant.

COLORADO

Cripple Creek.—The most important development at the Cresson mine since the discovery of the rich 'vug' in 1913 has been made in the north-western area of the Cresson estate beyond the crater at the 1700-ft., or Roosevelt tunnel, level. The ore-shoot as now developed on this level is better than 130 ft. long, with a width averaging 25 ft. over its entire length. The ore, shipped as broken, is returning between $20 and $40 per ton. The same shoot has also been opened up at the 1600-ft. level and as the ground above is virgin, it may carry through to surface. On the 1600-ft. level stoping has been commenced with the orebody holding its strength as in the deeper working. The shoot was originally found by diamond-drilling. The greatest value of the discovery is that it strengthens the prospect for other important discoveries in the same undeveloped area. The Cresson is shipping eight to ten cars of 30 to 35 tons capacity daily.

A fill on the old Florence & Cripple Creek railroad (now dismantled), near Hollywood, made from waste from the Strong mine at Victor, in the days of high-grade production from that property, when all waste was hauled by the railroad free under the 'right-of-way' contract, is now being hauled to the Independence mill of the Portland Gold Mining Co., where it is netting around $10 and $12 per ton. Under a contract, $1 per ton was paid for the privilege of removing and shipping this rock.

Georgetown.—Operations are planned on the O'Connell group in West Argentine by Los Angeles operators whose representatives, Irving E. Bush and J. H. Harris, are on the ground.——The Arapahoe group in East Argentine is again active, with L. W. Vidler in charge.——Among other properties on which work is to be resumed in August is the Centennial, to be operated by the Indemnity company, recently incorporated.

Telluride.—The Belmont Wagner Mining Co., a subsidiary of the Tonopah Belmont company, of Tonopah, Nevada, has resumed operations at the Alta following 10 months inactivity. During the shut-down contractors were engaged in extending the Black Hawk tunnel to permit economical transportation of mill ores. The mill is now treating tailing. Sixty miners and millmen are employed, and, when

operating at capacity within the next 60 days. 200 additional men will be required.——The Suffolk mill is being overhauled and the Suffolk claims are being developed by the Summit Metals Mines Corporation.——The flotation unit of the Valley View Leasing Co., at the San Bernardino, is turning out a high-grade concentrate from San Bernardino mine ores.——Flotation equipment is being installed by the Matterhorn Mining & Milling Co., of which Park J. Dills is manager.

Ore of good grade has been opened at the mill-level of the Silver Bell at the Ophir loop. The property is owned by Wisconsin capitalists; operations on company account are to be resumed. The find was made by lessees.——The Smuggler-Union is operating its flotation unit with satisfactory results, and with other units completed the mill will have a daily capacity of 1000 tons.

IDAHO

Coeur d'Alene.—The Great Northern railway has announced new freight-rates on ore and concentrate from Great Northern points to the Bunker Hill smelter at Bradley, Idaho, effective August 19. They should be of great benefit to shippers. According to Frank M. Smith, smelter director of the Bunker Hill company, the new rates, which make possible the shipping of ore and concentrate to the Bunker Hill smelter, are based on ore of $30 value to the ton. Each increase of $10 per ton in value up to $100 is reflected in a 25-cent increase in freight-rates. To Nelson, B. C., the rate is $3.75 for $30 ore, increasing by 25-cent increments to $5.50 for $100 ore. To Libby, Montana, and to Porthill, Idaho, the rate is $3.25 minimum and $5 maximum. Salmo, B. C., Ymir, B. C., Boundary, and Republic all take rates of $3.50 minimum to $5.25 maximum. Troy, Montana, takes a rate of $3 to $4.75; Nighthawk, $4.95 to $6.70; Oroville, $4.83 to $6.60; Ruby, $5 to $6.75; and Tonasket and Okanogan, each, $4.75 to $6.50.

The Sunshine Mining Co. has shipped a carload of ore and is loading another. E. C. Tousley, general manager, expects to ship four carloads during July. Five were shipped in June, one of which contained 266 oz. of silver per ton and yielded $4000 net.

The property includes the Yankee Boy and Yankee Girl mines on Big creek. A 50-ton mill, equipped with ball-mills and flotation, is to be started. While the predominating value is silver, the ore contains some lead. Fifty-five men are employed in the mine and on the construction of the mill. W. F. Newton is superintendent.

Shoots of rich gray-copper ore have been uncovered in the Hecla. Stringers six inches wide have been followed for 25 ft. on the 600-ft. level; the assays show 1% lead, 16% copper, and from 95 to 500 oz. silver per ton.

The 200-ft. raise between the No. 1 and No. 2 tunnels in the Pilot mine on the North Fork has been completed. A vein on this property with a 'pay' streak next to the wall contains from five inches to a foot of ore exceedingly rich in both silver and gold, according to reports.

Night Hawk.—A mill of 50-ton daily capacity is being installed by the Four Metals Mining Co. on its property, three miles north of here, on the Similkameen river. The plant will be equipped with two ball-mills, two jigs, five tables, and a flotation machine. It is expected to produce a concentrate containing 6% copper, 38% lead, and 60 oz. of silver per ton. The quantity of gold in the ore is small. The source of ore is a shoot six feet wide between walls and opened by a tunnel and a 100-ft. shaft. A depth of 300 ft. can be attained by the tunnel on the vein. E. Steffes, of Edmonton, Alberta, is manager.

Eureka, Utah, Showing the Centennial-Eureka and Bullion-Beck Mines that Were Re-opened Last Week

KANSAS

Treece.—The Lennan mill has been entirely removed from its former situation near Commerce and is being re-built on the lease of the Waschusetts Lead & Zinc Co. in West Treece. J. H. Klinefelter, of Picher, has charge of the work. The mill will have a daily capacity of 350 tons. The field shaft-hopper and the tram to the mill have been completed and a 12-in. and a 14-in. pump are being repaired and installed.

MONTANA

Barker.—The operators of the Wright & Edwards property have 25 miners actively engaged in operating the mine; 1250 tons of ore assaying 35 oz. silver, and 40% lead is awaiting haulage to the railroad. Difficulty is experienced

in having a motor-truck road constructed, because of the fact that the mine is in Judith county, and Monarch, the nearest railroad point, is 12 miles distant, in Cascade county.

Butte.—Ex-Senator W. A. Clark has formally offered to underwrite the entire issue of $1,000,000 in City of Butte bonds at par. On account of the inactivity of mining, city warrants had become unsaleable and the finances of the town were in a critical condition. Eastern bond-houses were disinclined to purchase the bonds. At this juncture Senator Clark came to the rescue.

NEVADA

Arrowhead.—The shaft of the Arrowhead is to be sunk from the present depth of 330 ft. to 600 ft. and a compressor and air-drills are to be bought for use in this work. It appears reasonably certain that building of a mill will be started in the spring.

Cherry Creek.—J. W. Walker, who is in charge of operations on the Mary Ann property, reports that the 800-ft. adit has cut the main Mary Ann vein. Drifting and cross-cutting is being done to determine the extent of the ore-body.

Divide.—The Tonopah Divide has resumed shipments to the Belmont mill at Tonopah, sending 35 tons daily, according to reports. It is said that 10 men are employed and that another shift is to be added.

Goldfield.—At a depth of 30 ft. in a winze from the 265-ft. level of the Red Top, the ore in the Silver Pick lease is 5 to 6 ft. wide and the average value for this width is $80, according to Mat Murphy, superintendent. The shoot has now been opened for a length of 45 ft. and for 45 ft. on the dip of the vein. Two carloads of ore have been shipped, the average value being estimated at $50 to $70.——The shipment made by Donald and Giles, lessees on the Florence, had a net weight of 17271/2 lb. and a net value of $2287.77 per ton, according to returns from Selby. The metallic content was 146.10 oz. gold and 10.90 oz. silver per ton. The lessees are now loading a 50-ton shipment of $150 ore.

Hornsilver.—The tenth carload of ore is being shipped from the Orlean. The winze being sunk from the 580-ft. level is 35 ft. deep.

Montezuma.—The 100-ft. shaft of the Harmill has been re-timbered nearly to the bottom. The shaft, formerly 3 to 5 ft. in the clear, is being enlarged to 4 by 7, and in doing this work a new vein, 8 in. wide, was found at a depth of 25 feet.

Round Mountain.—The report of the Round Mountain Mining Co. for 1920 shows a net operating deficit of $15,932.78, caused by a short season for placer mining, the payment of $30,000 for water-rights and pipe-lines, $5000 for the purchase of stock in a mercantile company at Round Mountain conducted for the benefit of the employees, $5233.24 for additional dam construction, $2210.08 for a drill-sharpener, $1422.64 for pipe and fittings, and $8682.25 for personal property and bullion taxes. Most of the indebtedness is to the Fairview Round Mountain, in which the Round Mountain owns 20% of the issued stock. During the year 64,665 cu. yd. of placer gravel was hydraulicked, yielding 4292.26 oz. bullion, worth $56,277.37, with $818.78 received as royalty from placer leases. On December 31 the main tail-race was 5276.3 ft. long, lined entirely with 25-lb. rails. Lode mining was done by the company until June 30, 1920, and 4513.1 tons of ore of a gross value of $23,475.29 was milled. On June 30 the company stopped work in the lode mine because of scarcity of labor and high costs. During the year lessees mined and milled $67,351.89 worth of ore, net.

Tonopah.—The first semi-monthly clean-up of the West End Consolidated mill resulted in 26 bars of bullion worth $59,510. The increased output is attributed to the ore being shipped by lessees at the Halifax Tonopah and Mizpah Extension mines.——Thirteen bars of gold-silver bullion, having an estimated value of $26,000, were shipped from the Tonopah Extension mill as a result of the mid-monthly clean-up in July. The company has put on another shift at the Victor shaft, and the work of unwatering below the 1760-ft. level is now under way. At the latest report, the water has been lowered to within about 50 ft. of the sump at the 1880-ft. level. When this has been accomplished, development and exploration work will be resumed at the bottom level of the mine.

The striking mine and mill workers voted recently to continue the strike. The West End employees continue to contribute $5 to $15 each monthly to support the strike, and the miners at Randsburg, California, report that they have sent $600. Clyde Heller, president, and Frederick Bradshaw, general manager of the Belmont, are here. Heller declares that his company will not recede from its position and that there is accordingly nothing to arbitrate.

OREGON

Gold Hill.—The recent purchase of the Sylvanite group of gold mines three miles from Gold Hill by the Oregon-Pittsburgh mining company, indicates the increased activity in gold mining in this district. This is a new concern organized recently under the laws of Arizona with a capital stock of $3,000,000; its headquarters are at Gold Hill and its main office at 307 Bessemer Bdg., Pittsburgh, Pennsylvania. The purchase price of the mine is announced to be $180,000. Gold was first discovered on the Sylvanite vein, or, as it is known locally, the Big vein, 40 years ago when it produced high-grade ore near the surface. Later, in 1916, tungsten was discovered in the mine and since that time considerable importance has been attached to the property, due to that find. The tungsten is found with the gold ore in the form of scheelite. The mineral occurs in small stringers with quartz. Samples have been taken from these stringers which assay as high as 40% tungstic acid, but the veins as a whole average less than 2%. The veins carrying the best grade of tungsten have been developed to a small extent, but the tungsten resources of the mine have not yet been determined.

It was later in 1916 that J. G. Davies and associates of Sacramento, California, took over the property and in two years operation recovered about $60,000, which was spent in developing and equipping the property. The mill equipment erected on the mine consisted of a 10-stamp mill with all auxiliary equipment for milling free ore. Early in 1919, Victor W. Brown and associates of Pittsburgh took an option on the property and have continued development with good results. The engineer in charge of the property, L. H. Van Horn of Gold Hill announces that the first unit of equipment for the reduction of the ores will be of at least 100-ton per day capacity. This applies to the treatment of both free-milling and base ores that are refractory and will require several processes. The Doan adit was driven on the vein at a depth of several hundred feet in the early history of the mine. It is advanced a distance of 1330 ft. This disclosed several bodies of high-grade ore. Work is now progressing through the Haff tunnel, which is a cross-cut tapping the Big vein at 650 ft. from the portal, and 65 ft. higher than the Doan level and 350 ft. below the surface. Several cross-cuts from the Haff level have opened good bodies of rich ore. About 120 ft. from the portal of the Haff adit a cross-cut was run north which at 28 ft. struck the Blind vein. A drift on the new find uncovered a body of rich ore. Continuing, this drift cut the Scheelite vein, so called because at the surface it yielded scheelite ore. At this point, however, it developed into a well-defined quartz with high-grade gold ore with the scheelite but little in evidence. The accompany-

ing photograph shows the mine and mill on the hill beyond the river.

Two miles south of the town of Gold Hill is the Braden mine. This property has been worked intermittently since the early 'sixties. Just south and east of the Braden mine are the Centennial, Millionaire, Roaring Gimlet, and Gold Ridge mines, all of which have passed through the same experience as the Sylvanite, but are now being put in operation again with the idea of mining deeper. Just across the ridge from the Braden on the west are the Bill Nye, Kubli, Red Oak, Tin Pan, and other smaller mines which have been the principal producers of this district and are still closed.

The recent reported uncovering of a large body of cinnabar ore, in the David Force quicksilver mine, which assays from 40 to 60% mercury is reported.——The War Eagle company has developed ore containing, in addition to mercury, large quantities of arsenic, some gold, silver, nickel, and zinc. Before resuming the company purposes to install equipment in its plant to recover several of the by-products.

The Sylvanite Mine Near Gold Hill, Oregon

Jacksonville.—The old Norling gold-quartz mine three miles west of Jacksonville on Jackson creek has been acquired by the Medford Mining & Milling Association, recently incorporated under the laws of Oregon. Recent work in the mine has uncovered a large body of ore assaying $9 to $18 per ton. During the first development of the mine in 1905-'07 it is reported to have produced 120 tons of ore worth $6400.

SOUTH DAKOTA

Lead City.—The Homestake Mining Co. is employing approximately 2500 men. It is producing $500,000 monthly in gold. A new hoist, one of the largest in the world, has been installed at the Old Abe shaft, thereby increasing the output from the lower levels. The Old Ellison hoist has been electrified, but is not in operation as yet. The company now is constructing a new 1000-ton mill in East Lead which will be equipped with a new type, 1700-lb. stamp. Each stamp will be capable of grinding from 8 to 10 tons of ore, whereas the company is now using in all the mills a stamp weighing about 900 lb., which will reduce only from four to five tons per day. When the new mill is completed the daily capacity will be increased from 4200 to 5200 tons.

The Trojan Mining Co.'s payroll is larger than it has ever been in the history of that company. It is producing $50,000 worth of gold each month and will probably increase this output. The acquisition of other valuable properties by purchase directly adjoining the properties of the Trojan company will probably result in adding to the mill.

UTAH

Alta.—Conditions at the Alta Tunnel & Transportation Co.'s property are reported as being the most favorable since development was started, according to F. V. Bodfish, manager. Raise No. 1, started at the intersection of the main fissure with a cross-vein, has cut a streak of high-grade silver-lead ore 8 in. thick. A bedded deposit of manganese, 20 to 25 ft. thick, has been cut by No. 3 raise. This bed overlies a stratum of low-grade ore, approximately 25 ft. thick, containing bunches of high-grade carbonate silver-lead ore.

Eureka.—Ore shipments for the week ending July 23 totaled 156 cars, the same as for the preceding week. The Tintic Standard shipped 51 cars; Chief Consolidated, 36; Iron King, 14; Iron Blossom, 12; Victoria, 11; Dragon, 10; Eagle & Blue Bell, 7; Swansea, 4; Gemini, 3; Colorado, 3; Mammoth, 3; Eureka Mines, 1; Sunbeam, 1.

The shaft at the Diamond Queen Mining Co. has been retimbered, and announcement is made that work of deepening the shaft will be undertaken soon. It is the intention to sink the shaft to the 500-ft. level, where drifting will be undertaken.——A new find was recently made in the Iron Blossom mine of the Knight companies, which appears to have great possibilities. The Dragon mine, also controlled by the Knight interests, is now outputting a large tonnage of iron ore.——The heading on the 500-ft. level at the Eureka Lily mine has been in ore for the last 60 ft. The material is low-grade, with high-grade seams throughout the mass. The drift on the 1400-ft. level has been cutting bunches of high-grade silver-lead-copper ore, according to Grant H. Snyder, manager.

Park City.—Ore shipments will be resumed shortly by the Naildriver property, according to J. D. Fisher, superintendent. A small quantity is being mined daily; the work

that is being done by lessees is progressing satisfactorily. ——Progress is being made in the erection of the new concentrating plant by the Silver King Coalition Mines Co. The steel-work is being set up as fast as it arrives, and about 70 men are now employed on mill-construction.

Shipments of ore from this district for the week ending July 23 totaled 1273 tons, as compared with 1475 tons for the preceding week. The Silver King Coalition shipped 565 tons; the Judge allied companies, 390, and the Ontario, 318.

Price.—The Raven Mining Co., owning elaterite properties in Duchesne county, has sold its holdings to the Elaterite Varnish & Rubber Co. of Los Angeles. This company is preparing to develop the deposit. The elaterite is valued at about $100 per ton and is shipped by motor trucks to Price, a distance of 75 miles. Most of the product is shipped to Los Angeles.

BRITISH COLUMBIA

Edgewood.—Basil Cortiana, principal owner of the Rampulo group, at Lightning Peak camp, has driven the adit 40 ft. since the beginning of July, and is within 35 ft. of its objective. A drift on the vein from the tunnel 100 ft. above has been driven 150 ft., exposing a six-foot vein of good ore.

Slocan.—The Silversmith Mines, Ltd., has issued its annual report for the fiscal year ended May 31, 1921. Expenditure, which included the acquirement of the Ivanhoe mill, mill-site, and water-rights from the Minnesota Silver Co., amounted to $240,298, and made a considerable inroad on the cash surplus. The reconstruction of the Ivanhoe mill, erection of the aerial tramway, and other improvements that now are being made will still further reduce this surplus. During the year 15,585 tons of ore was mined, 134 tons of which was shipped in the crude state, the remainder producing 2021 tons of lead concentrate, which was sold, and 2000 tons of zinc concentrate, which is being stored pending the finding of a profitable market. The ore sales realized $260,404, compared with $205,996 in the previous year. The Ottawa mill has been started, and is said to be giving complete satisfaction. It depends entirely on flotation for concentration of the ore.

MEXICO

Durango.—American capitalists are interested in the purchase of the old Salida mine in the Velardena district, which was allowed to go by default. It has been re-located as La Providencial. This property was worked prior to the revolution, the ores being treated at the Torreon and Velardena smelters. The ores contain silver and lead.——The furnaces of the American Smelting & Refining Co.'s smelter at Velardena are being kept heated by wood as fuel to prevent them from freezing up and cracking while the plant was shutdown.——Some shipments are being made from the Velardena to the Torreon smelter by small independent shippers.

The Concordia group of four mining claims has been re-located by Plutarco Almieda, representing W. Dartling. They are located in the Tamazula district in the municipality of Topia and include the old Prieta mine which contains gold and silver ores.

Parral.—The San Francisco Mines Co. made a fair profit for its last financial year with the present small plant, but the drop in metal prices has produced small losses. It is, however, believed that when the new 250-ton plant is in operation, which should be the case from January next, fair profits will be made even on the present price level. Development is in a backward condition, but, pending the erection of the new milling plant, milling of ore from the reserves will be suspended and development pushed forward, so that by the end of the year the position should have improved materially in this respect. During the remainder of this year, moderate profits are expected to be made by re-treating the 43,000 tons of residue, on which all mining and milling charges have already been paid, and also by milling certain carbonate ores from the upper levels not included in the ore-reserves.

Parral.—Pedro Alvarado, the former mine laborer who became a multi-millionaire by his discovery of rich silver ore on the ground that developed into the famous Palmillo mine, it is reported has just sold fifty-one of his mines to the Mexican Natural Resources Co., of San Antonio, Texas, for $6,000,000 United States money. Alvarado came into public notice about 15 years ago, soon after his rise to sudden fortune, by offering to pay the public debt of Mexico. General Porfirio Diaz, who was president at the time, refused the offer. For many years Alvarado distributed large sums of money among the poor people of Parral by making a trip through the streets once a week, scattering silver coins as he went along. The mining properties which Alvarado has just sold are situated in the States of Chihuahua, Durango, and Sonora. It is the intention of the company acquiring these properties to proceed with the development as rapidly as possible and to that end there are already in the field a staff of field engineers consisting of C. C. Coulter, George C. Hinton, Ernest E. Underwood, and E. B. Bunte, who have a completely equipped laboratory in Parral and are engaged in making a survey and report on each of the properties.

Santa Rosalia.—The Compañia del Boleo, an important copper mining and smelting concern, operating in Lower California, according to Consul Bartley F. Yost, of Guaymas, is enlarging its smelter through the installation of a converter plant for the purpose of refining the matte and blister in its own plant, instead of shipping it away for refining, as has been done heretofore. The cost of the machinery and installation is estimated at about $1,000,000 and the company has floated bonds to that amount. All the machinery was purchased in the United States. As the company owns a fleet of steamers it is intended to transport the copper bullion through the Panama Canal to New Orleans and Galveston, where it will be trans-shipped to New York. The company owns a tank steamer for bringing crude-oil from Tampico to Santa Rosalia. On its return trip it will be loaded with copper bullion.

Torreon.—Simon de Avila and associates of this district have recently located a group of six claims in the foothills of the Sarnosa mountains west of the city of Lerdo. Preliminary work on these claims has produced some good silver-lead ores.——Work is now being carried on at the Mapami mines of the Cia. Minera de Penoles and the ores are being shipped to their smelting plant at Torreon.

At San Juan de Guadalupe, a short distance south of this city, Eugene Leroy has taken over the Gardenia and Chabusco mines. These properties have produced considerable high-grade silver-lead ores and are again being put in shape to continue production.

Zacatecas.—General Rios Zertuche, associated with his brother, Dr. Daniel Rios Zertuche, has taken up a large group of claims in the Pinos district. The denouncement embraces a number of old abandoned mines which in former years produced large quantities of silver-lead ores which were shipped to the nearby smelters. The new title to this group is the Anexas a Tres Amigos. Development work is planned in order to put the old workings in shape for actual mining.——Clemente Vergara has also applied for titles to the La Luz group of mines in the Mazapil district. His filing has been recorded with the mining agent at Zacatecas city.

ONTARIO

Bourkes Station.—The mine buildings at the Bourkes mines were recently destroyed by a bush fire, causing a loss of about $25,000. The mine had been closed for about a year.

Kirkland Lake.—The Lake Shore during June recovered $52,539 from the treatment of 1656 tons of ore, being an average of $31.64 per ton. The mill ran only 75.9% of possible running time, owing to power difficulties.——Final arrangements have been effected for the re-opening of the Sylvanite. It was originally planned to include this mine in the merger, which resulted in the formation of the Kirkland Lake Proprietary (1919), but it was found difficult to secure control of the stock. It is now understood that J. G. Latilla of London has secured and exercised an option on stock held by William Wright, and effected a satisfactory arrangement with Buffalo stockholders identified with the Wright-Hargreaves for the development of the property. Albert Wende, general manager of the Wright-Hargreaves, will derect operations. The production of the Wright-Hargreaves for June exceeded $51,000 in spite of the loss of nearly 25% of the possible running time due to the failure of the power company to supply electricity. Development work is being directed to opening the 200-ft. and lower levels.——At the King Kirkland another vein from 7 to 10 ft. wide has been found on the surface. It is heavily mineralized.——The drift at the 300-ft. level of the Bidgood has been in ore for upward of 100 feet.

Porcupine.—A new orebody discovered on the McIntyre by diamond-drilling has been cross-cut on the 1375-ft. level, where it shows a 30-ft. width of ore assaying $20 per ton. The vein is supposed to have come in from the Hollinger, the boundary of which is several hundred feet distant. In the main shaft a station is being cut at 1625 ft. When this is completed the work of deepening the shaft to 2000 ft., with stations at 1750 and 1875 ft., will be started.——At the Porcupine Paymaster the main vein is being driven on at the 200-ft. level with encouraging results. The vein is 20 ft. wide in places, with parallel veins of importance running in close proximity. The shaft will be deepened to 400 ft.——The shaft of the Beaumont, formerly the North Davidson, is down 300 ft. and a station is being cut at that level.

SPAIN

Madrid.—The following decree regarding the granting of concessions for the exploration and operation of mines appeared in the 'Gaceta de Madrid' of June 15, according to a Consular report:

Article 1. On and after the date of publication of this decree in the 'Gaceta de Madrid' mining concessions will be granted only to Spaniards or companies formed and domiciled in Spain, it being required in the latter case that the president of the Council of Administration, the administrative delegates, the managing directors with the power of signing in the names of the companies, and the engineers charged with the works be Spaniards. Only one-third of the other offices may be held by foreigners. The above-mentioned concessions may not be ceded or transferred except to persons or entities fulfilling the stated requisites.

Art. 2. All concessions authorized will be under the condition that the material and machinery used in the exploration and operation of the mines shall be of Spanish production and manufacture, and that the use of foreign material and machinery will only be authorized in the case where it is shown, before the Commission for the Protection of National Production, that it is absolutely impossible to obtain them in Spain on account of their not being produced here.

The Government will make its decision without further recourse.

Art. 3. The present concessionnaires of mines and those being registered on the date of this decree will continue to enjoy the rights authorized by their concessions, and only in their new installations will have to comply with the conditions of the above article with regard to materials and machinery.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

V. N. Franchie was in San Francisco this week.

F. L. Sizer has returned from Grass Valley, California.

F. A. Voorhees, of Los Angeles, is at Mojave, California.

Augustus Locke is at Butte, on his way to Calumet, Michigan.

Henry S. Burnholz has moved from Torreon, Mexico, to New York.

Robert B. Brinsmade has moved from Ixmiquilpan, in Hidalgo, to Mexico City.

Cornelius F. Kelley, president of the Anaconda Copper Mining Co., is visiting Butte.

Arthur Gibson is now with the Maxine Mining Co., at La Porte, in Plumas county, California.

C. G. Patterson has moved from San Juan de Limay, Nicaragua, to Piedmont, California.

E. J. Franklin, mechanical engineer for the Ray Consolidated Copper Co., is at Salt Lake City.

Frank D. Pagliuchi has left for New York. He expects to return to San Francisco in about a month.

John P. Benson, of Berkeley, California, is now with the Grecia Mines Co., at San Juan de Limay, Nicaragua.

Howard D. Smith is here from New York. He is about to examine a group of mines in Nevada county, California.

Forest Rutherford has returned to New York City after completing some mine examinations in Northern Ontario.

J. E. Robison was in San Francisco this week; he will sail from New York for the Belgian Congo in about a month.

George H. Dern, mining engineer of Salt Lake City, has returned home after a five weeks trip to New Mexico and Arizona.

A. W. Newberry has been employed by Weld & Liddell, consulting engineers of New York, to examine a mineral property in Montana.

J. O. Greenan, for the past year engineer in charge for the Keno Hill company, at Mayo, in Yukon Territory, has returned to his home at Berkeley.

Harold Cogswell has left the Idaho-Maryland Mines Co., at Grass Valley, California, and is now with the United Comstock Mines Co., at Virginia City, Nevada.

Charles F. Raney, formerly efficiency engineer for the North Butte Mining Co. and now with the E. I. Du Pont de Nemours company, is in San Francisco from Denver.

T. Horiuchi, director of the Meiji Mining Co. of Japan, and **Y. Takahashi**, chief mining engineer for the Tanaka Mining Co., are visiting mining districts in this country.

Chris G. Dobson, of the faculty of the College of Engineering, University of Washington, Seattle, is now doing special engineering work for the Gold Reef Mining Co., at Cornucopia, Oregon.

C. Minot Weld and **Donald M. Liddell** will continue to practise as consulting engineers and economists under the name of Weld & Liddell, at 2 Rector St., New York, the partnership of Weld, Liddell & Lazenby having been dissolved.

Olaf P. Jenkins is in charge of the field-work of the Washington Geological Survey, and is investigating certain road materials, the Grand Coulee as a reservoir site, and the iron ores of Washington in relation to the possible manufacture of iron and steel.

Frederick W. Denton, vice-president of the Copper Mining Co., has been appointed as a member of the Board of Control of the Michigan College of Mines at Houghton. He succeeds James MacNaughton, general manager for the Calumet & Hecla Mining Co., whose term has expired.

THE METAL MARKET

METAL PRICES

San Francisco, August 2

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.00—13.50
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$70
Platinum, 10% iridium, per ounce	$88
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

August 1.—Copper is inactive and weak. Lead is quiet and steady. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
July 26	61.25	38.75	June 20	58.77	35.18
" 27	61.62	39.00	" 27	58.69	35.25
" 28	62.37	39.50	July 4	58.90	35.33
" 29	61.25	38.87	" 11	58.69	36.75
" 30	61.75	39.12	" 18	60.25	37.56
" 31 Sunday			" 25	60.14	37.85
Aug. 1	61.75	Holiday	Aug. 1	61.66	39.05

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
July 26	12.25	June 20	12.85
" 27	12.12	" 27	12.68
" 28	12.12	July 4	12.62
" 29	12.00	" 11	12.62
" 30	11.87	" 18	12.62
" 31 Sunday		" 25	12.43
Aug. 1	11.87	Aug. 1	12.04

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
July 26	4.40	June 20	4.47
" 27	4.40	" 27	4.32
" 28	4.40	July 4	4.43
" 29	4.40	" 11	4.43
" 30	4.40	" 18	4.40
" 31 Sunday		" 25	4.40
Aug. 1	4.40	Aug. 1	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.60	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
July 26	4.75	June 20	4.95
" 27	4.75	" 27	4.88
" 28	4.75	July 4	4.75
" 29	4.75	" 11	4.77
" 30	4.75	" 18	4.76
" 31 Sunday		" 25	4.72
Aug. 1	4.75	Aug. 1	4.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
July 5	48.00	July 19	47.50
" 12	48.00	" 26	47.50
		Aug. 2	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

GASOLINE AND BUSINESS

A striking situation, and one having a most important relation to the general economic conditions throughout the country is shown in the unprecedented accumulation of gasoline stocks as recorded for the month of May, and the unexpected decline in consumption. For many years the curves of increases and depletions in the country's gasoline stocks have followed a normal course of increase in winter, continuing from October to April and a lowering of the curve from April to October. The reason, of course, is the starting each summer of maximum use of motor-cars and trucks, with a resultant lowering of storage stocks of gasoline, followed by a re-building of stocks in the winter months of minimum car use.

The present year, however, presents a remarkable departure from the normal trend in that there was a complete break in the normal rate of increased consumption in May. Month by month, the country had been using from 2,000,000 to 3,000,000 gal. of gasoline more per day in 1921 than in 1920. This continued in April of the present year. But in May the total consumption, including exports, was less on a daily basis than in the preceding April, and the country used 1,700,000 gal. per day less than in April 1920. On May 31, 1921, there was 800,000,000 gal. of gasoline in storage, which is the highest stock of record for the United States.

This complete reversal is a natural reflection of general economic conditions, both at home and abroad. There have been less exports and shipments to our insular possessions. During May the domestic consumption exceeded that of April by 21,000,000 gal., but the exports were 17,000,000 gal. less. Considering stocks as a whole, at the end of April 1920, there was 643,552,644 gal. on hand, while at the end of April 1920 there was 577,671,795 gal. on hand, or a running down of the stocks of about 70,000,000 gal. in May 1920. Quite different are the comparative statistics for the same month this year. On April 30, 1921, there was 747,222,900 gal. of gasoline on hand, and at the end of May there was 800,045,787 gal. on hand. In other words, instead of a depletion in the stocks of approximately 70,000,000 gal., as occurred within the same period in 1920, the stocks were actually built up by 53,000,000 gal. during May of the current year. The relation of consumption to the use of automobiles and trucks, while a matter of common knowledge, will be more definitely appreciated through figures showing the total number of such vehicles registered and the production of gasoline during the same years.

Year	Production of gasoline in millions of gallons	Automobiles and trucks registered in the U. S.
1920	4883	8,500,000
1919	3958	7,559,000
1918	3570	6,147,000
1917	2850	4,983,000
1916	2059	3,518,000
1915	1467	2,446,000

The answer to the anomaly of an increase in gasoline stocks in May, instead of a decrease, and a decrease instead of an increase in consumption as might normally be expected, is a decreased use to a very marked degree of automobiles and trucks in the United States during the month, as compared with the previous month, or with the corresponding months of previous years; also to a decrease in exports.

MONEY AND EXCHANGE

Foreign quotations on August 2 are as follows:

Sterling, dollars:	Cable	3.57
	Demand	3.58
Francs, cents:	Cable	7.72
	Demand	7.74
Lire, cents:	Demand	4.30
Marks, cents		1.25

Eastern Metal Market

New York, July 27.

Buying of all the metals is 'spotty', and prices in some cases are lower. There is no evidence of any revival and none is looked for before fall.

Necessity of sacrificing speculative lots has resulted in lower prices for copper, with light buying.

There has been some buying of tin at lower prices.

Demand for lead is moderate, but prices are unchanged.

There is little life to the zinc market, with values fairly firm.

IRON AND STEEL

Further settling of steel prices has come in the past week, and in some products the downward movement has been rapid, says 'The Iron Age'. Informal announcement of a 1.75c. price for steel bars and of 1.85c. for plates and structural shapes—a $3-per-ton cut below the July 5 schedule—was made in the week by several independent producers, but already somewhat lower prices are reported, indicating more aggressive competition in practically all markets.

Some encouragement is found in the larger tonnage under inquiry, but it is well recognized that in such a market no approach to price stabilization is to be expected. Every producer is meeting competition as it develops.

That the Steel Corporation's earnings for the second quarter were better than most predictions is ascribed in part to its unique advantage in railroad ownership and the fact that, for nearly all the second quarter, Chicago business was done on the Pittsburgh base.

Operations by Steel Corporation mills are running close to 30% this week, an improvement over the previous July average. Railroad-car repair-work is gradually being arranged for. Railroad material inquiries continue to feature the international markets. In August 12,000 tons of rails are to be bid on for Chile and 3000 tons for Morocco. Some 12,000 tons will be bought for a new Bolivian railroad and 1000 tons of light rails are wanted in Manila.

COPPER

Buying of copper is not heavy and what there is is spasmodic and of an uncertain nature. It is confined, as to sellers, to speculators or small producers' interests who, for financial or other reasons, are obliged to sell as the month of July comes to an end. This situation has resulted in offerings of electrolytic copper at concessions under what most large interests are willing to consider. While reports are to the effect that some sales have been made as low as 12.12½c., delivered, for July-August, a fair appraisal of values seems to fix 12.50c., delivered, as the present market, with lots here and there available at lower levels. The large producers are maintaining one asking price of 12.75c., delivered, or 12.50c., New York, but would probably shade this on desirable business. The Lake copper market is inactive at 12.50 to 12.75c., delivered. Buying for foreign consumption is moderately good. There is active inquiry for casting copper from China, with some purchases recorded.

TIN

Outside of three moderately active days last week there has been little business. On those days it is estimated that about 500 tons of future shipment Straits tin was sold, both consumers and dealers being the buyers, the latter predominating. Later there were few sellers, and buyers also were disinclined to purchase, in the confident belief that prices would be lower this week. This has been realized, the market breaking quite sharply yesterday and Monday, the quotation yesterday having been 26c., New York, against 27 to 28c. the week previous. The market is now quiet and weak. There has also been a decline in London quotations, those yesterday having been £158 5s. for spot standard, £160 5s. for future standard, and £158 15s. for spot Straits, all about £3 per ton lower than one week ago. Arrivals thus far this month have been 1270 tons, with 2865 tons reported afloat. One seller feels strongly that there will be no revival of any consequence for a year now that the canning season has passed and evidence being fairly good of stocks of some proportions in the hands of consumers.

LEAD

It appears that the leading interest is able to meet the light demand that exists at its regular quotation of 4.40c., New York, which we quote as the market. The St. Louis quotation of the same producer is also 4.40c., but independent producers are quoting 4.35c. and taking such business as is offered in that market. The latter sellers, however, in New York, are not at present a factor and almost nothing is heard of any offerings in the outside market. The market may be characterized as very quiet and barely steady.

ZINC

One large seller characterizes last week as the most stagnant in his memory, there having been three successive days on which there was no inquiry of any kind. This week there has been more demand which has resulted in good sales, a few 100-ton and smaller lots of prime Western going at 4.25c., St. Louis, or 4.75c., New York. The 4.20c., St. Louis, offerings of last week appear to have been eliminated. The buying referred to has been mostly from galvanizers bare of stocks and able to operate on recent orders. 'Brass-special' is quiet and selling at 4.35 to 4.40c., St. Louis.

ANTIMONY

Wholesale lots for early delivery are obtainable at 4.65c. per pound, New York, duty paid. Offerings from the Orient are lower at around 4c. in bond, New York, which has resulted in a fair amount of buying of futures.

ALUMINUM

Virgin metal, 98 to 99% pure, is now quoted by the leading producer at 24.50c., f.o.b. plant, in wholesale lots for early delivery, with imported metal of the same grade available at 22 to 23c., New York.

ORES

Tungsten: A little business is reported consisting of odd lots, but while inquiry is a little better there is no activity. Quotations or unchanged at $3 to $3.25 per unit for good ores.

Ferro-tungsten: The market is without life and quotations are nominal at 48 to 58c. per pound of contained tungsten in lump form, guaranteed quality.

Molybdenum: A little inquiry is reported but quotations are nominal at 50c. per pound of MoS_2 in regular concentrate.

Manganese: There is absolutely no demand, with quotations nominal at 22c. per unit, seasoard.

Manganese-Iron Alloys: The markets for both ferro-manganese and spiegeleisen are stagnant and quotations are nominal. For American ferro-manganese the asking price is $75, delivered, while the British price is $70, seaboard, but it is acknowledged that these could be sharply shaded were there any demand. Spiegeleisen, 20%, can be bought as low as $26, furnace.

Ferro-silicon, 50%, is quoted by leading sellers at $65 per ton, delivered.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.50 to 2.00
" " " " " carboys "	2.60 to 3.10
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	9.00 to 9.50
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.50 to 6.50
" powdered, in barrels "	5.75 to 6.60
" glass, ground, 30 mesh, cases, tin lined, per 100 lb	18.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	0.31
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per ton	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO_2, — ¾% Fe), in casks, per ton	140.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.18½
" " " " granular " "	0.18½
" " " " powdered " "	0.19
" carbonate, calcined, in barrel lots, per lb	0.25
" permanganate, in drums, per pound	0.70
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.50
" bicarbonate of " "	3.50
" caustic, ground, 98% " "	6.50
" " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft	393.00
Conduit, galvanized iron, ¾ in., per 100 ft	12.20
" " " 2-in. "	37.35
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	19.20
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	21.50
" " " 14, single-braid, rubber-covered " per 1000 lb.	7.95
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" " porcelain, 6600 v., No. 44, per 100	21.50
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.00
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	28.80
Telephone wire, iron, size 12, half-mile lots, per 100 lb	10.25

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.25
" gelatine " " " "	19.25
" ammonia " " " "	18.25
Fuse, common, in case lots, per 1000 ft	8.50
" waterproof, triple tape, in case lots, per 1000 ft	10.54

FUELS

Coal, Utah steam, $4 at mine, plus $7.50 freight to California terminal points, in carload lots, per ton	11.50
Coal, blacksmith's, in carload lots, per ton	24.00
" " in small lots, per ton	27.00
Coke, in carload lots, per ton	26.00
Fuel oil, per barrel	1.75
Diesel oil, per gallon	0.06½
Distillate " "	0.16½
Gasoline " "	0.24½

HARDWARE

Anti-friction metal, per pound	0.24
Babbitt, genuine "	0.54
Brass sheets, half-hard and soft, per pound	0.28
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅞ by 2-in., per 100 lb	9.30
Nails and spikes (20d to 60d base), per keg	4.75
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	10.75
" cold punched " "	12.30
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	18.00
Track spikes, per 100 lb	6.10

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.75
Rails, steel, 8 to 25-lb., per 100 lb	4.54
Reinforcing-steel, per 100 lb	3.75
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.80
" flat " " " "	6.70
" flat, black iron " "	5.90
Structural T's, channels, angles, and beams "	3.85
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	7.10
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	13.30
" " galvanized " " "	16.70
" " black " 4-in. "	58.00
" " " extra strong " "	113.75
Shafting, cold-rolled (2¼ to 3-in. base) "	5.50

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
" " extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	90.00
Fir, common, base price, per M	30.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	36.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	100.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	90.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White pine " " " "	180.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb. cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.00
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.15
" " " 2 (standard), per pound	0.14
Packing, flax, per pound	0.38 to 0.90
" sheet "	0.35 to 1.00
" steam or water, first grade, per pound	1.00
Silex lining, crated, per long ton	35.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	30.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.00
" sheet, 36 in. by 84 in., in ton lots, per 100 lb	14.00

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots	60.70
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	3.25
Portland cement, in bags, per barrel of 380 lb	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	12
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 7c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump, white, per ton	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn	5
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

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T. A. RICKARD, ... Editor

IF in these times of depression we have escaped a financial collapse it is due largely to the Federal Reserve Bank, which has given our national monetary system a stability such as it did not possess before. We believe firmly that the directors of the Federal Reserve Board have exercised their highly responsible functions with skill and fairness, therefore we have no sympathy whatever with the attacks now being made upon them in Congress.

GOODWILL between the two English-speaking nations of North America is proved by the unfortified boundary of 3500 miles that divides them so amicably. Another evidence of friendliness is the decision of British Columbia to establish the rule of "turn to the right" for vehicular traffic. This change will come into effect on January 1 next. The confusion due to having a "to the left" rule on the northern side of the boundary and "to the right" on the southern has been the cause of many inadvertent collisions; and the illicit trade in spirituous liquors, since the 18th Amendment went into effect, is said to have supplied another cause of accidents on the road. Safety first!

AGRICULTURE and mining are said to be the two basic industries. Apparently the older one receives most sympathy from Congress, at the expense of the tax-payers. A bill has been introduced to provide a billion dollars for the purchase of farm products. This is class legislation with a vengeance. Exports of farm products have been on an enormous scale during the last year. Up to May of this year 334 million bushels of wheat and 56 million bushels of corn had been exported, as against 198 million bushels of wheat and 14 million bushels of corn in the preceding fiscal year. A bloc, or organized group in Congress is behind this pernicious legislation, for which there is no valid excuse at this time.

FOREIGN mining companies operating in Spain will be hard hit by the proposed new taxation law, which, if given the royal assent, will lead to the withdrawal of capital and the migration of foreign technicians and business men. Spain, as a neutral, profited greatly from the War; the bank-rate was fixed at 4%, with the result that money went abroad, to be invested at higher interest. Since the Armistice, much of the accumulated wealth has been spent on luxuries, and not in anticipation of the slump that follows the boom as inevitably as the night follows the day. The present drastic measure against foreign enterprise will hurt Spain no less than those who have invested their money and their abilities in expanding her industries.

THE official organ of the Union of German Metal Workers, 'Metallarbeiter', publishes the result of an investigation on the question of the increases in wages and the cost of living in Germany since 1914. In all about 2,300,000 workers were considered, and it was found that 63% are now receiving wages that indicate a rise of 800% over those of 1914; 36%, from 500 to 800%; and the remainder, less than 500%. As the cost of living has advanced about 1550% during the period under consideration, it is obvious that conditions in Germany are such that a great deal of credit must be given to that industrious country for having accepted the maxim that work is the best cure for many ills, individual and national. Germany is showing the world how it is possible to weather an economic crisis.

TEMPERAMENT and environment are factors that must be taken into consideration in deciding the length of the working day. The Association of Technical Workers in Germany recently decided that the retention of the eight-hour day in that country is an economic impossibility; it is claimed that the loss of 17 billion marks by the railroads during 1920 was due to the inefficiency that followed the introduction, immediately after the Armistice, of shorter working-hours. It is claimed that a return to the twelve-hour working day is imperative; with the extra four hours of leisure the German worker falls a prey to habits of dissipation, which unfit him for serious effort. This will astonish the members of labor-unions in the United States; to them it will seem a reversion to obsolete and archaic ways of thinking. The suggestion that rest from labor must lead to dissipation is archaic.

PROVIDED all the delegates come to the proposed disarmament conference at Washington with a realization of the stupidity and futility of war, then much initial progress will have been made toward a reduction of the economic waste that is crippling the world, and crippling it to no ultimate good purpose, mental, moral, or

physical. There must be no quibblings and no half-measures. Complete and universal disarmament is the ideal. The great powers can inculcate the truth by example; they can insist, by moral pressure, on its recognition. If there be still any nations that wish to resort to an archaic and barbarous method of settling a dispute, then the present is the best time to convince them of their mistake. In the proposed disarmament conference lies the hope of a disillusioned world.

THE latest bulletin issued by the American Mining Congress draws attention to the mention, in a U. S. Geological Survey report, of the closing of the North Star and Empire mines at Grass Valley, and asserts that "their closing emphasizes the contention that the cost of mining is not declining". This is a blunder of statement and of inference. The two mines mentioned have resumed operations, as noted in our issue of July 30. Moreover, the closing of these mines was due not to the persistence of high costs but to a disagreement between the managements and the men in regard to the extent to which wages should be lowered in conformity with the decline in the cost of living. The Congress bulletin proceeds to say: "It is expected other mines will close unless Congressional relief is afforded". Nothing of the kind is expected in California. We are expecting a re-opening of idle mines, and we have good reason to expect it, because the decline in the cost of supplies and in the rate of wages has improved conditions considerably.

DURING the first half of the current year the production of gold in the Transvaal declined to 678,490 ounces, as compared with 715,957 in the corresponding period of 1920. However, the enhanced value of the gold as measured in the paper currency of Great Britain raised the monetary yield to £3,646,883, as against £2,883,582 for the first half of last year. The so-called premium is greatly helping British gold-mining companies all over the world, for the reason that they do business in the paper pound, not in gold sovereigns. For example, Mr. John H. Cordner-James, speaking as chairman at a recent meeting of the Oroya Links company, owning a mine in Western Australia, stated that the company's operations would have been conducted at a considerable loss during the last fiscal year if the premium received on the gold had not come to their rescue. "It's an ill wind that blows nobody good"; but it is obvious that the depreciation of the pound sterling in Great Britain does not begin to compensate for the relatively small economic gain accruing from a premium on the metal produced from the gold mines exploited under the British flag. Meanwhile it helps our friend the miner, and we are glad of that.

A DENVER newspaper, namely, the 'Rocky Mountain News', displays lamentable ignorance when writing on the gold problem. In an editorial article it is asserted that "American bankers are paying premiums on foriegn gold and loading up their reserves with it. American gold production is away down so that it counts for little in the total, whereas foreign gold production is being maintained from the American premiums paid". This is nonsense. American bankers can buy gold at the Mint for $20.67 per ounce, as of old; they are paying no premium to anybody, because the American dollar will buy as much gold as before; the dollar is at par. On the other hand, the pound, franc, lira, and mark are each and all of them at a discount, which discount places gold at a premium in England, France, Italy, and Germany, but that premium does not exist in relation to the U. S. dollar, because the dollar has not depreciated in terms of gold. The producers of gold in foreign countries are obtaining no advantage from an "American premium", which is the figment of a disordered imagination and an ill-informed editorial mind. Those who produce gold in foreign countries, such as South Africa, owe their advantage to the discount on the pound sterling, which is worth as much less in gold as it is in U. S. dollars. That is all.

NEW ways of turning to account the benefits of co-operation are appearing continually. An instance is the project of Mineral county, in Nevada, for constructing and owning an electric-distribution system and for conducting a retail business in electric power that it will buy at wholesale rates from the Nevada California Power Company. The company formerly maintained a line of transmission from its hydro-electric plant at Lundy, in California, to Hawthorne, in Nevada, and thence to Fairview and Wonder. When the Nevada Hills and Nevada Wonder mines were at length exhausted there was no important market for power in these districts, and the line connecting the mines with Hawthorne was torn down. The company later made application for permission to remove the remainder of the line, whereupon the citizens of Mineral county protested that this would not only leave their towns literally in the dark but would seriously interfere with the development of the many small mines wherein lies the chief hope of the county's future prosperity. At this juncture someone suggested that the county bond itself to finance the construction of a power-line and then sell electric energy to the mine operators and others who desired to purchase. It was pointed out that the county had authority to issue bonds for the construction of roads; that roads were of little value to those living in the county unless the mineral resources were exploited; and that the most effectual way to promote mining was to supply electric power to the operators of small mines. A special bill providing for a bond-issue of $150,000 for the purpose of building the line was endorsed by 90% of the property owners in the county, including the Southern Pacific railroad company, which incidentally pays more than half of the taxes, and was enacted by the legislature without opposition. The Supreme Court of Nevada passed favorably on the validity of the Act, and the bonds were issued. Sundry investment brokers offered to underwrite the issue at a substantial discount, but Mineral county wanted 100 cents

on the dollar. Here was another chance for co-operation. The Industrial Commission of Nevada gets 90% of its funds from the mining industry; the stimulation of mining will benefit the Commission; the financing of Mineral county's project will stimulate mining in Nevada. Accordingly, the Commission decided to invest $75,000 in power-line bonds at par. This was a good start, and since then every bond has been sold at its full face value. The material has been purchased, and within a year a trunk-line so located as to bring power within six miles of all the promising districts in the county will be completed. The most important of these are the Simon and Candelaria districts, but Lucky Boy, Hawthorne, Luning, Rand, and Mina are centres of active prospecting and development; they are expected to flourish when electric power is available.

SEVERAL interesting contributions appear in our 'Discussion' department this week. To Mr. Bain's letter we make special reference elsewhere. Mr. Chauncey L. Berrien is the General Superintendent of Mines for the Anaconda Copper Mining Company, and when he writes about mine ventilation one can feel assured that he knows whereof he speaks. Mr. Berrien quotes at length from a Bureau of Mines report, to correct an impression that might have arisen as the result of an abbreviated reference in an editorial of ours to atmospheric conditions in the mines of Butte; he is inclined to question, as we did in discussing the matter in the first instance, the conclusion as to a rise of body temperature under such conditions. The Anaconda company has earned a reputation for initiative and interest in mining hygiene; its policy has always been to spare no expense in an effort to create healthful conditions underground. Mr. G. L. Holmes writes on the subject of another report issued by the U. S. Bureau of Mines station in Alaska. Our friend Mr. Alfred James, a recognized specialist in cyanidation, throws additional light on the subject of regeneration of cyanide after precipitation of the gold in solution. Mr. E. M. West writes from Tonopah to throw a brick at a grinning wild-cat incubated in his own district. From far-away Batavia, in Java, we receive a note from Mr. J. Egerton Wood on a disputatious subject, the value of gold. It will be noted that he found a gold sovereign worth 18 francs, whereas a paper pound was worth only 10½ francs, so that the premium on the gold was over 47%. Mr. R. B. Elder, who writes on the measurement of surface-tension, is Assistant Professor of Metallurgy in the School of Mines of the University of Idaho. His letter is timely, because on the next page we print an important article on the same subject by Mr. A. W. Fahrenwald, who is Ore-Dressing Engineer in the Field Office of the U. S. Bureau of Mines, at Moscow, Idaho, and is working in co-operation with the Idaho Bureau of Mines and Geology at the University of Idaho. Mr. Fahrenwald's method of measuring surface-tension ought to prove of great service in elucidating many of the obscure problems of the flotation process, with particular reference to adsorption phenomena.

Consolidation of Mines

Combination, followed by unification of control and management, often affords the best solution of an industrial problem, as we pointed out recently when commenting on Mr. Henry Ford's offer to lease the Muscle Shoals plant and to operate it in conjunction with a new automobile factory. It is not always, however, that the more prosperous partner is willing to saddle his enterprise with the incubus of a venture of questionable outcome. Recently, the South African government appointed a committee of engineers to consider ways and means to avoid the closure of the East Rand Proprietary company's mines, on the Witwatersrand. The suggestions made by the committee included one that was favored in the majority report, to the effect that arrangements should be made between the East Rand and the Cinderella Consolidated companies, which are neighbors, to operate the two properties as one concern. This suggestion has not been met with enthusiasm by the Cinderella Consolidated officials; they are anxious to give the East Rand company every assistance in helping to surmount the difficulty, but they state that, from their own point of view, it would be more satisfactory to wait for the resumption of operations, and until such time as the Cinderella Consolidated is able to arrange its own finances, so that the mine may operate as a separate entity. With this end in view, optimism is expressed concerning the future prospects of the company as a profitable producer, provided it remain independent. On the other hand, the Cinderella company cannot view with complacence the prospect of the calamity that would inevitably result locally from the closure of the East Rand Proprietary mines, and has expressed a willingness to consider any reasonable proposal with regard to an amalgamation.

One notes the somewhat arbitrary advice in the majority report of the committee to the effect that the consolidation, presumably in the interests of South Africa and of the industry, should be carried out. Is it against common sense to suggest that a government is justified, morally or constitutionally, in preventing the decay of an industry by insisting on a consolidation of the prosperous with the needy? Ore ceases to be 'ore' when it cannot be extracted and treated at a profit; but if a mine that contains such material be situated next to one that possesses ore of such a grade that its prosperity for many years is assured, then the waste on the other side of the boundary-line assumes the prospective character of 'ore'. This being so, is it unreasonable for a government to conserve its mineral resources by insisting that all ore that can be treated at a profit shall be so treated, even if this be possible only by a consolidation between two or more companies? The suggestion opens interesting possibilities, for it is certain that many deposits would assume a vastly greater economic importance if such an average could be made. The question draws attention to the advantages of large-scale operation, unified control, and cheap methods of beneficiation.

Professional Advice From the U. S. Bureau of Mines

We take pleasure in publishing a letter from Mr. H. Foster Bain, the Director of the U. S. Bureau of Mines, with reference to an editorial in our issue of June 11 on the work being done at the Fairbanks station. We agree with Mr. Bain that the special conditions in Alaska justify some widening of the scope permissible to the engineers of the Bureau, and that under such conditions they may properly give detailed advice without trespassing on the field of the consulting engineer; in fact, our mention of this phase of the work was merely incidental to our criticism of the specific report regarding the treatment of tailing after amalgamation. As is natural, Mr. Bain defends the metallurgist whose work we criticized, and he does it most disarmingly. Nevertheless, in spite of the explanation offered, we venture to reiterate our conviction that the conclusions and recommendations in the original report were based on unsound metallurgical and economic principles. However, nothing can be gained by further debate on this matter. We are quite content to give space to Mr. Bain's friendly demurrer.

It is necessary, nevertheless, to point out that the technical man must base his judgment of the work of the Bureau on the reports as published, not on miscellaneous related facts that may be known only to the writer of such papers; on what the writer says (for intance, about the feasibility of cyaniding sulphide concentrates), not on what he may happen to know; and on what the writer advises to be done, rather than on what he may have in his mind to do after the plant is in operation. Mr. Bain manifests his appreciation of the shortcomings of this particular report in these respects at least. Even if we should concede that the general recommendations are based on sound metallurgical theory and practice, the report as it stands could be, it seems to us, of little value to the operators in the Fairbanks district; they would require so much supplementary advice that complete instructions might better be sent in the form of a letter. To the engineer who is not directly concerned with the Alaskan operations the report is either misleading if he be inexperienced, or ridiculous if he be one who has specialized to an extent that permits him to see its faults. The only possible function of the report might be to add one publication to the total number that is expected to impress the politicians, who hold the purse-strings, with the importance of the work of the Bureau. We hasten to disavow any inference that such could have been the purpose of publishing the report in question. Mr. Bain asks for constructive advice, and he is entitled to it, for his administration of the Bureau calls for the friendly support of the mining profession. We venture, therefore, to suggest that if the Bureau is to maintain its excellent reputation for honest technical research it must give more attention to the proper preparation of the reports that are distributed and published under the name of its engineers. A single unfortunate publication will spoil the good effect of half a dozen valuable ones. Possibly we were brusque in our criticism of this particular report; if so, the curtness was due to a desire to be emphatic. The end in view was to forestall a repetition of a mistake that is injurious to the reputation of the U. S. Bureau of Mines.

Motor Traffic and Road Construction

Slogans are often lacking in common sense and logic. 'Build the roads to carry loads' is one that should be analyzed from the economic point of view. According to Mr. J. N. Mackall, the chairman of the Maryland State Roads Commission, the availability of money does not mean the construction of roads. The building of a nation's highways is a physical problem rather than a financial one; and the speed of building is limited to the materials and the mechanical equipment that is available and can be made available for the purpose. The makers of railroads were never confronted with the task that is now before the constructors of highways; the former could control the traffic over their lines. Although weight and speed have advanced enormously during recent years, these increases have never been sanctioned until the permanent way, the alignment, and the grade had been modified to meet the altered conditions. The highway engineer, on the other hand, is confronted today with the task of designing roads over which he has no control. The slogan should be, 'Limit the load to one that the road can carry'. If the user of the road, or the one who is interested in road construction, considered the economics of the subject, he would lose his enthusiasm and interest in roads for heavy traffic. Instead, he would favor the construction of roads to be built to withstand the wear and tear of trucks of moderate size, and the maintenance of those highways that are able to carry such traffic. This contention is supported by an example that serves to emphasize the need for a consideration of the economics of road construction. A census was taken of the traffic on the Maryland section of the road from Philadelphia to Washington, through Baltimore, during 1918, when long sections were destroyed by motor-trucks. In this census the trucks were classified according to size. It was demonstrated that, if all loads that were carried on units of five tons or more had been carried on units of three tons, the excess cost to the operators would have been $15,000; whereas the cost of repairing the damage, a large portion of which was caused by the heavy loads, was $600,000. An enormous economic waste is indicated; the figures serve to emphasize the futility of attempting to build and maintain a highway system under such conditions. There are today many more miles of road in satisfactory service than can be constructed during the next twenty years. Are these to be worn out in a few years by the traffic of a few exceptionally heavy trucks; or is transportation to be limited to vehicles of such a weight that the roads can be maintained in normal condition without inordinate expense for repairs or for re-building?

Charcoal and Wood-Oil Manufacture

The distillation of various oils from wood, and the production of charcoal and other by-products, are interesting features of the activities of the St. John Del Rey Mining Company, at Morro Velho, in Brazil. According to the annual report, the distillation plant there, of American manufacture, has a capacity of 200 tons of charcoal per month. The production for the past year was more than sufficient to meet local requirements, the surplus being sold. The supply is never equal to the demand; prices obtained are satisfactory. Another important by-product is calcium acetate, of which 181 tons was sold during the year. Gasoline is exceedingly expensive in Brazil, so the production of wood spirit, for use as a substitute, is of economic significance. During the year 71,000 litres was distilled, and 36,000 litres was sold. Tests with tractors showed that the spirit-fuel gives about two-thirds the duty of the same volume of gasoline, and improved results are anticipated in the future. No detrimental effects have been observed, by the substitution of wood spirit, on the cylinders and valves of internal-combustion engines; such working parts are reported to be in perfect condition after lengthly tests.

Wood-tar is another important by-product at Morro Velho. During the year an attempt was made to adopt it as a fuel in the refinery, as a substitute for charcoal, and with entirely satisfactory results. Fourteen tons of such material per month is now used for melting the gold; advantages are obvious, and economies are claimed. The brass-melting furnaces in the repair-shops are also being converted; and further uses for the local tar are being discovered. The engineering staff of the Oeste de Minas railway carried out successful experiments, in which tar from the company's distillation plant was used as a fuel. The light oils and pitch produced during the process of refining the crude tar are consumed in other operations. The insulating material used in the construction of the cooling-plant was made from cork grown in the neighborhood and from pitch obtained from the distillation plant; the efficiency of the covering leaves nothing to be desired.

The transport, by pack animals, of wood from the forest is expensive, difficult, and unsatisfactory. Various schemes have been considered to replace or to supplement the present freighting system by a less costly method of transport. Wire-rope tramways apparently are impracticable. Roads for light lorries driven by wood-alcohol have been suggested. It is realized that, if Brazil is to move with the times, some attempt must be made to replace the present primitive methods of transport, so as to avoid a criminal waste of time and money. Unfortunately, however, the country is confronted with a financial crisis; the St. John Del Rey company has no market at present for its calcium acetate. For this and for other reasons the general manager, Mr. George Chalmers, expects that it will be necessary to reduce the activity and the output of the distillation plant. Whatever the effect of the economic crisis may be on this phase of the company's operations, it is evident that the officials have made a praiseworthy effort to meet abnormal conditions, and that a technical success has resulted from their enterprise. Charcoal is used extensively as a fuel in mining districts; the distillation of crude oil from wood is apparently so practicable that other companies, similarly situated, are likely to utilize local raw material for the production of fuel for motors, as well as other valuable by-products.

Tube-Mill Pebbles and Colloids

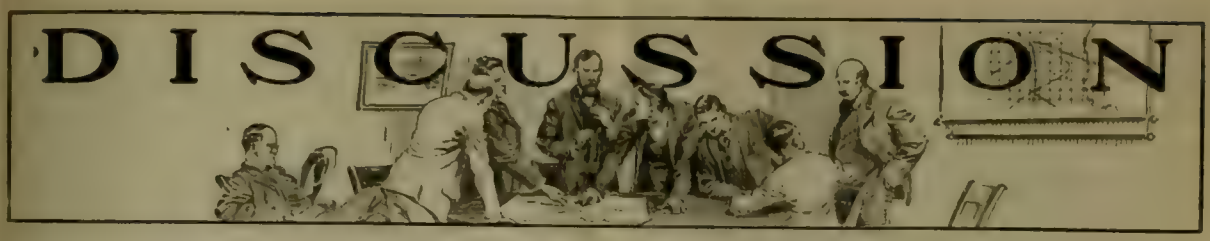
The investigation of technical advance in other industries would add to our knowledge much that is essential. At present we obtain such information in a haphazard way. A certain amount of overlapping in research is inevitable, but it is doubtful whether any appreciable advantage is taken of investigations on subjects in which we are not directly interested—information that, if sifted and classified in a manner that would make the essential features clear and the applicability obvious, would be of immense value. As an example of this we refer to the use of artificial pebbles in the crushing of ore. The mining industry, as has been its wont, muddled along for many years without scientific guidance as to the character and the properties of the rock that should be used as a grinding medium in tube-mills. Flint pebbles were imported from Europe at enormous expense to serve this purpose; we could afford the first cost, the freight, and the other charges. Many of these stones had been subjected to alternating periods of cold and heat for centuries; a large number of them cracked and chipped with the first revolutions of the mill. Nevertheless it was maintained that the imported article was not only of superior quality, but that its use was an essential to successful grinding. In a few instances, however, the cost of haulage to a reduction plant in an isolated district was so great that the use of a cheaper substitute was considered. Rough mine-rock was tried, but in the majority of cases the results were unsatisfactory; it chipped and broke; the efficiency of crushing was seriously reduced by the accumulation of gravel and sand in the tube-mill. Power was wasted; although the grinding medium was ore, this advantage was more than countered by the reduction in the output of the re-grinding plant. An effort was then made to find a barren-rock substitute of approximately the same character as the imported pebble. It was ascertained that such material existed almost everywhere; it could be mined or quarried, and shaped to a size that was consistent with the work it would be called upon to perform in the mill. A preliminary tumbling treatment in a cylinder resulted in the production of a pebble of the same appearance as the European water-worn flint. Sceptics said, "It is softer than the imported article", which was true; but, in determining the requirements of a first-class tube-mill pebble, other factors must be taken into consideration. The hardness of the material used for grinding is of no significance if the stone breaks easily under impact; and this is what happened to a large proportion of the imported pebbles. In one instance, two piles of pebbles were made; one of these

was of imported flints; the other, of shaped stones of felsite, selected according to a diameter (and, accordingly, weight) that suited the requirements exactly. The tester, standing about six feet from the pile, would throw, in succession, a number of European pebbles among others of the very same character, with the result that many were unable to withstand the impact. The imported pebbles were hard, but they were also brittle; the chippings produced in the mill during normal operation required a considerable expenditure of power before they could be reduced to fine sand or slime. The same test carried out with the felsite stone showed no fracturing and no chipping, but some abrasion. The substitute could be manufactured for much less than the European pebble could be purchased and hauled to its destination; comparative tests in the tube-mill showed it to be more efficient as a grinder because of (1) uniformity of size; (2) greater weight per unit volume; (3) absence of chipping and fracture; and (4) comparative roughness of surface, thus permitting a better grip during the grinding.

At this stage it was realized that a scientific appreciation of the factors of hardness and toughness of pebble and rock would be of value, and an examination was made of current technical literature. This proved a tedious task, but it was fruitful of result, for it was found that a large amount of experimental work had been done, on the testing of rock for road-building purposes, at the laboratories of the Office of Public Roads and Rural Engineering. It was then realized that the essential features of road-metal, namely, hardness and toughness, are also the essential features of tube-mill pebbles. The selection of a proper rock for ore-crushing was therefore practicable at the minimum of trouble and at a negligible cost, for the laboratories at Washington are equipped with apparatus by which accurate and scientific tests can be made on any type of rock, and its suitability or unsuitability as a grinding medium can thus be determined. The testing of rock has been carried out on so extensive a scale that the bulletins of the Office contain details as to deposits of suitable stone in almost every locality, and their availability for the manufacture of an efficient and inexpensive substitute for imported pebbles.

At the Colorado meeting of the Institute in 1918 a paper, by Mr. Luther W. Lennox, was discussed. In this the author showed that a fair idea of the comparative friability of ores could be obtained by the use of a small tube-mill, loaded with steel balls. The sample, it was explained, was crushed to a coarse mesh, graded and weighed, then introduced into the testing machine, together with a definite amount of water. After a predetermined period of grinding, the ore was removed and an estimate was made, by screening and weighing, of the amount of the sample that had been ground to pass a screen of a certain mesh. From this a value was obtained representing the friability of the ore. The model tube-mill was somewhat similar to the apparatus known among road-building engineers as the Deval abrasion machine, used to determine the French coefficient of wear, except that no balls are used in the latter case, and the axis of the mill is at an angle with the horizontal, with the result that a greater abrasive effect is produced. Thus it happened that an engineer in a private capacity developed a scheme for estimating the hardness of rock, a subject that had already received considerable attention, and on which large sums of money had been spent, in another industry. This will indicate the need for the systematic recognition of contemporary research. Mining and metallurgical engineers can turn to no comprehensive index and résumé of current technical literature, compiled by one who appreciates the value of a pertinent scientific fact, irrespective of its source; the economic waste that results from the unnecessary overlapping of research appears inevitable until such a résumé is available.

One man's meat is often another man's poison. Colloids of clay and of other earthy substances are the bane of many a chemico-metallurgical operation, but they are the delight of the maker of fine porcelain, and are of value to the agriculturist. A method of determining quantitatively the amount of colloid in a slime would have ensured the avoidance of many a fiasco in filtration; a scientific analysis of the physical characteristics of an ore is often as important as a chemical or a metallurgical analysis. The hardness and the toughness of a rock can be determined, as we have shown, by means of the apparatus described in the reports of the Office of Public Roads and Rural Engineering, and the friability by Mr. Lennox's method; but a determination should also be made, among others, of the colloid content; and in this connection we are glad to borrow some suggestions from the Bureau of Soils of the U. S. Department of Agriculture. Recently a paper, by Messrs. C. J. Moore, W. H. Fry, and H. E. Middleton, on 'Methods for Determining the Amount of Colloidal Matter in Soils', has been published; the experiments that have been and are being made should arouse the interest of the mining and metallurgical fraternity. From this paper it is learnt that a method for isolating the true colloid was perfected. An 'ultra-clay' was produced that was unfilterable; it proved to be a much stronger binding agent than portland cement. Two methods were devised to determine, quantitatively, the amount of colloid present in the soil. In the first case the results were based on the power of the dry colloid to adsorb a gas (ammonia); in the second case, to the power of a colloid in the form of an aqueous solution to adsorb the dye from a true solution. The experiments are being continued; the results should be followed by those who are interested in the physical characteristics of rocks, decomposed or disintegrated, all of which, when sufficient metal is present, may be designated 'ore'. We draw attention to the work of the Bureau of Soils in an attempt to emphasize the importance, to the mining and metallurgical fraternity, of the research that is being done, particularly with regard to the estimation of the physical characteristics of rocks and soils, in our Government departments.



Professional Advice From the Bureau of Mines

The Editor:

Sir—In your issue of June 11 you have been good enough to discuss one of the very real problems faced in the administration of the Bureau, although, unfortunately, you have done so on the basis of a single example, and, as I think, without quite your usual breadth of view and insight. In your editorial there are two material criticisms, first, as to the policy of the Bureau ever giving advice to individual producers which might be obtained from a practising engineer, and, second, as to the value of the particular advice given. With your permission I will discuss these separately.

There can be no real difference of opinion among engineers inside or outside of the Government service as to the soundness of the rule that those working for the Government should not trespass upon the proper field of those who earn their living by the application of their technical skill in general practice. Indeed, so far as the Bureau of Mines is concerned, this is not only a matter of fundamental policy, but is, by strong implication, prohibited by the organic law. It is, however, a principle of interpretation that no law requires an executive officer to desert his common sense, and the brilliant editor of the 'Press' has himself accepted the rule that all rules are subject to exceptions, "except that a man must be present while being shaved".

The work of the Bureau in Alaska is considered to fall among the exceptions, and this conclusion was reached deliberately and after mature consideration of the particular conditions to be met there. The experiment station was established at Fairbanks to pioneer and with full knowledge that the character of its work would necessarily differ from that of those in the States. Approximately 98% of the land in Alaska is still owned by the Government. The conditions faced by prospectors and miners in the Far North are difficult to an unusual degree and they deserve and should have every help which the Government can give. Under the leasing system, which applies to the coal and petroleum lands, the Government is a continuing partner in each enterprise and directly interested in its success. In securing development of the other mineral lands of the Territory the Government has the interest in making a land market that any other large land-owner would have. It has in both cases the larger and more important interest in public security and welfare which will result from making in our northern territory homes for people and building up strong, well-founded, and economically independent communities. For these reasons the Bureau has felt warranted in going further in giving direct aid to miners and prospectors than in its regular work in the States. The situation is not the same as where much if not all of the land has passed into private ownership, where industries are established and running, where standard practice has been developed and is well known, and where private facilities for investigative studies and tests are abundant. There are now no facilities available for making tests other than those of the Bureau. It hardly seems justifiable under these conditions to raise the cry of competition with private enterprise.

The tests made at Fairbanks, of which one formed the basis of your criticism, were intended to suggest to operators in interior Alaska the possibility of additional gold-recovery from their ores after amalgamation. The tests were made on an amalgamation tailing obtained from one among several similar properties in the Fairbanks district. The mines are all small, the ore occurring in veins usually less than a foot in width. Development has not been carried on to demonstrate a large tonnage and the owners are in no case prepared to make large expenditures. There are no practising metallurgists in interior Alaska, and none of the properties in the Fairbanks district are yet on a sufficiently large operating basis to warrant the expense of individual investigations. That these tests were in the nature of a preliminary investigation is suggested in the concluding paragraph of the report, which reads: "Whether concentration and cyanidation, or flotation, is to be adopted, should be determined by tests of a representative amalgamation tailing derived at least in part from sulphide ores." I believe that with this larger knowledge of the situation you will agree that this was a proper activity on the part of the Bureau and did not in fact constitute a case of trespass.

With regard to your criticism of the tests themselves, I am persuaded that the real fault is more with the form of statement, or perhaps the making of any public statement, than with the work itself. Only a part of the work done was described. It had already been demonstrated in a number of cases that in the amalgamation of the Fairbanks ores, no economic improvement could be expected.

A few runs only were made in a custom-mill on the ore from this particular mine, and the accumulated tailing was not sufficient to warrant the erection of a plant for mixed sand and slime. The attempt to leach mixed sand and slime for current production, it was

believed, would simply result in a tank-charge impervious to solutions. Cyanide tests were made on the different products from table concentration to determine the extractions on each. The results obtained by such tests determine whether it is advisable to cyanide the concentrate with the sand, or to remove the concentrate for separate treatment, or for shipment to a smelter. The ratio of solution to ore in the tests was two to one. The mention of this in the report was not deemed necessary, as the important point (the cyanide and lime consumption in pounds per ton of ore) is given for each test. This consumption was not excessive nor was it higher (except in the case of slime treatment) for the longer treatment.

As to the bottle tests, there is room for difference of opinion. Much depends on the exact method followed and the amount of reliance placed upon the results. These particular tests were made by hand agitation which simply means occasional agitation during the day and none at night. Moreover, the removal of all the solution by repeated washing was not attempted; only enough water for washing being used to bring the solution back to the original volume. Such a method does not yield over-high results, the chief danger from bottle tests. As a matter of fact, Mr. Gross, who did the work, has made similar tests in a number of plants in actual operation and checked results by extraction over periods of several months and found the bottle results slightly below mill-recovery and the cyanide and lime consumption above. For preliminary work on small properties, bottle tests are far from being useless and they should not mislead an experienced operator.

The statement that high extraction cannot be expected from sulphide concentrate was not intended as a general dictum but referred to concentrate from the particular ore tested and was based upon results obtained from testing this and smiliar ores in the Fairbanks district. Neither was it intended to convey the idea that this concentrate could not be so treated as to give a good extraction, but that under conditions existing in the quartz mines of the Fairbanks district a high extraction from a sulphide concentrate is of improbable economic value. The fault here is in rhetoric, rather than technology, and is cheerfully and fully acknowledged. Per contra the implication of the critic that Mr. Gross was entirely ignorant or regardless of the literature of the subject is amusing in view of his experience in the cyanidation of sulphides which dates back to the elaborate studies of Draper and Gross at Central City in 1910, and has extended through a wide experience as an operator in Mexico and the United States.

In the outline of the mill suggested, the table would remove a concentrate if necessary for shipment and would discard the slime. While it might appear that a high loss is occasioned by not treating the slime, anyone familiar with conditions in interior Alaska would hesitate to recommend its treatment at present. A table of the Wilfley type can make a sand product sufficiently free from slime to allow wet loading in a tank and to ensure satisfactory leaching; in other words, the table could not only be used as a concentrator if required, but would also take the place of a drag-classifier. It was not suggested that the concentrate from the table should be cyanided separately. In case a high-grade concentrate was not obtainable, the entire table product, except slime, should go to sand-leaching tanks. The table, in this case, should be used simply for the removal of the slime, although at any moment ready to remove a concentrate if desirable.

There is no reason why an excessive amount of water should be sent to the tanks with the sand-pulp. If the sand-pulp be not contaminated with an undue amount of slime, a leachable charge will be obtained.

As it was not intended to use an alkaline mill-water, the return of the water to the mill need be considered only in case of shortage. The alkalinity for the protection of the cyanide would be obtained after the removal of the water by placing the required amount of lime on the top of the charge to be taken up by the solution. This method was found to be satisfactory in a mill operating under the same conditions.

It is true that all solutions from leaching-vats should not pass through the zinc-boxes, but in a small plant where only one vat is being leached at a time, simplicity of construction and the avoidance of having zinc-boxes standing idle (which does not improve their efficiency) are perhaps sufficient reasons for passing all solutions through the boxes. While it is admitted that it might be better, even in such a small unit as the one proposed, to carry two solutions in the plant, it is a minor point of treatment easily initiated in the mill if found advisable.

The flotation tests on the slime were preliminary tests made for the purpose of determining whether an operator would be justified in considering flotation in the treatment of his ore. The tests on this particular ore did not make a shipping-grade concentrate, but an extraction of 62.7% of the gold can certainly be considered as sufficiently encouraging for further tests, which are stated in the report to be necessary.

With this explanation I think it will be agreed that the faults seen by the critic are due rather to failure in presentation than to the scope and character of the tests made. The latter were designed to meet a particular condition and are believed to have done so. The men most concerned, living in the community and participating in the work, lost nothing by the over-brevity of the report, a fault possibly due to over-earnest effort to meet the criticism of the 'Press' on the bulk of Government printing.

As I mentioned at the beginning, the matter is one phase of a large problem that must be met in the administration of the Bureau. Your New York contemporary has already referred to it and I should be glad to have further discussion and the advice and help of fellow-members of the profession in determining the correct lines of activity for the Bureau in bridging the gap between laboratory results and commercial practice. How is the difficult and expensive stage of semi-commercial

development of processes to be passed? Many problems are to be met here and the officers of the Bureau are by no means cocksure that the methods now followed are wholly sound. They have at least the merit of evolution and of having grown out of experience. The system of research fellowships, of temporary semi-commercial operations and co-operative agreements does produce results and does have points of merit, but no one can be more conscious than those in the Bureau that it is also open to criticism. Can any one point to a better way that is applicable under actual conditions? Your help is cordially requested and will be sincerely appreciated.

Now may I say just one word to recall the fact that it is constructive criticism that helps and that when in the judgment of a critic he must write in terms of destruction, a sympathetic tone is never out of place? Specifically it does not help to attract to or hold in the Bureau men of broad operating experience when their reports are referred to as "a joke". I submit with all fairness the past services of the Bureau warrant a keener effort to get at the missing facts in the case even where the fault in presentation rests with the Bureau.

Washington, D. C., July 15. H. Foster Bain.

Ventilation and Phthisis

The Editor:

Sir—In your issue of June 4, 1921, page 770, you called attention to a preliminary report upon 'Ventilation and Miners' Phthisis', and particularly to the fact that out of 1018 miners examined 432, or 42.4%, were found to be suffering from phthisis.

Owing to the fact that some might misconstrue this to mean that 42.4% of all miners in Butte are suffering from phthisis, or miner's consumption, I wish to call your attention to the statement on page 10 of the preliminary report quoted as follows:

"There men presented themselves for examination at the office of the Butte Anti-Tuberculosis Society after notice had been given verbally and by printed card that all miners who would come to the office at certain hours would be examined free of charge. No examination was made of all of the miners of the Butte district or all those of any particular mine. Of those examined, a large proportion knew or thought they were infected when they presented themselves. Of those examined 432, or 42.4%, showed definite signs of dust injury to the lungs. Practically all of these men were either still working or had quit within the previous two or three months."

You can readily realize from the quotation of the full paragraph that very few, if any, miners would submit to physical examination unless there was suspicion that they were affected by the disease, consequently a very high percentage of those examined would show symptoms. In fact, it is rather surprising that the percentage was not higher when it is realized that only 1018 submitted to examination out of a probable total of 20,000 miners employed in Butte at that time.

Calling further attention to the article in question, I note that you quote from the Bureau of Mines Report as follows, "in most of the working places examined in Butte the temperature was well above 70°F., little or no movement of the air was perceptible, and the humidity approached saturation. Comparatively little work in such places causes body temperature quickly to mount from 98°F. (normal) to 103° or higher—that is, to fever temperatures".

We believe these results were obtained by noting the effects on Bureau of Mines observers rather than on the hardened miner. In justice to the mining companies in Butte, and particularly to the largest operator in Butte, I think your quotation of the report should have been extended to include the following:

"While the upper levels of the mines in this district were being opened, a considerable quantity of low-grade ore that was not of commercial grade then was left unmined. Because of the great reduction in mining costs during the last few years, the better price for copper, and, particularly, the lower cost of production, and the increased percentage of recovery, this ore is now of commercial value. Recovery of this ore has necessitated the reopening of many of the upper levels, and hence the operation of a large number of levels at the same time. For this reason, it is difficult to ventilate properly all of the working places in such mines; however, the mining companies are working as expeditiously as possible to extract this low-grade ore in order to eliminate as many levels as possible and to confine mining to fewer levels. The companies intend when this ore is extracted to seal off the worked-out levels with concrete so as to prevent the good fresh air from being vitiated.

"Almost all of the mines have one or more upcast shafts besides the operating shaft, which at nearly every mine is the downcast, and an effort is being made to have every operating shaft a downcast.

"Large, double-intake, reversible Sirocco fans, electrically driven, are installed at the collars of most of the upcast shafts. In some mines No. 11 Sirocco fans, also electrically driven, are used as boosters in the lower levels with satisfactory results, and in most mines small electrically driven fans with canvas pipe or tubing are installed in raises, drifts, and crosscuts to force the fresh air from the main air passages to the dead ends. *One company purchased at one order 325 of these small fans. This company has nearly completed plans, after working three or four years on them, that will double the volume of air circulating in its mines. Nearly all of its mines are ventilated independently of adjoining mines, and an effort is being made to provide independent ventilation for the others.*

"One working shaft is nearly all of solid concrete, a large number of other working shafts are coated with gunite, and a large number of upcast shafts are smoothly lined with concrete slabs, thus making the shafts fireproof and at the same time reducing the frictional resistance for the air. The smooth surfacing of these shafts permits almost a doubling of the velocity of the upcast, and thus doubles the quantity of air that can be

exhausted per minute by the large suction fans at the collar. One mining company has planned and has authorized continuation of this work, so that when its plans are completed every one of its working shafts will be coated with gunite and every one of its upcast shafts will be smooth-lined with concrete slabs.

"The conditions at the deeper Butte mines are difficult and intricate, and the mining companies have for many years past spent much time, energy, and money in efforts to solve the problems involved. Much progress has been made, but much remains to be done. *The recommendations following are offered with full knowledge that many of them are already in effect at some mines, but with the hope that their adoption may become general.*"

I desire especially to remind you that the Anaconda Company had initiated the changes in ventilation and general operating conditions some time before the U. S. Bureau of Mines began its investigation, and is continuing such work as rapidly as possible. The recommedations suggested by the Bureau of Mines had been and still are the methods of common practice in mine ventilation and their adoption has become general, but cannot be carried out in a short period of time throughout twenty-five operating mines.

C. L. Berrien.

Butte, July 14.

Gold From Black Sand

The Editor:

Sir—As I have been away on business for some weeks I did not get my 'M. & S. P.' regularly and find, on returning here, that my screed which appeared in yours of May 14 has elicited a response from Mr. Gross. To set forth my reasons for my comment on the paper 'Recovery of Gold from Black Sand', which appeared in your issue of April 9, I will beg your indulgence again.

To quote from the original article: "most of the gold present was 'contaminated' with quartz, as the free particles of gold had been removed by amalgamation". We must remember that the gentleman is speaking of placer gold and that by free gold he evidently means gold which is absolutely free from any 'contamination' with quartz or other material, and not 'free gold' as known to the quartz miner.

In the letter of June 25, Mr. Gross states: "The purpose of the investigation was not simply to recover the gold contained in this black sand but *to ascertain some method whereby the placer miner could, without too much expense, either in the way of labor or additional equipment,* make a better saving on this material".

For the benefit of Mr. Gross I will state that I am familiar with conditions existing (or as they once existed) in the interior of Alaska, having made some extensive trips in that country as early as 1900 and later having owned some ground on O'Brien creek in the Forty-Mile country. I must also take issue with him on his statement that "black sand is a local term". This term is used all over the world in placer-mining circles to denote just what it calls for, "black sand", heavier than the general mass of the placer material, which remains behind as a concentrate in the pan or sluice. In various districts we have sands of other colors which remain behind, the 'ruby sand' of Nome is an example, and such material should preferably, in a pseudo-scientific article describing tests made at a Government Experiment Station, be properly described or called by its proper name rather than by some misleading colloquialism.

The object of the test was "to ascertain some method whereby the miner could, without too much expense either for labor or additional equipment, make a better saving on this material". Then why resort to classification when classifiers are expensive, to Abbé mills which are also costly and are not in general use in placer-mining districts and are not carried in stock in remote regions by the general stores. Jigs were also used and a properly made jig is also an expensive (comparatively) piece of apparatus which the average placer miner knows neither how to construct nor how to use. Where, in a remote placer-mining region would one find a miner capable of determining that the "rising velocity in the classifier was exactly 54 ft. per minute"?

Mr. Gross would possibly be a bit more correct in his statement if he said that the average Alaskan does not regard 11c. per pound material as being of much value when in comparatively small quantities. A real placer miner takes more pride in his work than would permit of his being careless in cleaning 770 lb. of such material.

Let us examine the facts. The gold "was contaminated with quartz", by which I understand that a portion of it had not been freed from its original matrix of quartz. Can we remove it by classifying? No. There is only 770 lb. of the material, but grinding this amount in a hand-mortar or on a bucking-board would be arduous, and these appliances might not be handy in a placer camp. What more natural then than the two flat stones I mentioned. Nothing but grinding is going to release the gold from its matrix and two flat stones of suitable size can be found at or near almost any placer mine. If this amount of material is to be recovered at every clean-up, and clean-ups are to be at weekly intervals throughout the season, a small arrastra could be built by driving staves into the ground in a circle, lining the bottom with flat hard stones and a sweep provided with drag-stones so that the operator could walk around the arrastra and grind the material fine enough to release the gold. I have seen such arrastras built in remote regions by artisans who had few tools and small skill in the mechanic arts. They are effective and accomplish the desired result with a minimum of labor and expense.

Some years ago, while visiting one of the Alaskan placer camps, I witnessed a clean-up and was surprised at the somewhat careless way a certain group of 'miners' handled their clean-up work. It also happened that this was the first clean-up that their new cook, an elderly lady from the Snake River country in Idaho, had witnessed. She remonstrated with them and was told that there was "no fine gold here". She did not believe the statement and begged them to throw their tailing from

the clean-up into a pile for her. Later I saw her carrying some of it in water-buckets to her kitchen, where she dried it in small portions in a clean skillet and resorted to skillful 'blowing' on a sheet of tin, which she had burned in the fire to remove the tin coating. I saw her get quite a nice showing of fine color, and, in the fall of the year, I saw her in Skagway homeward bound and found that her efforts with the supposedly valueless material had netted her some $15,000 for the season. She had been brought up in a placer-mining country by careful parents who were placer miners themselves.

With placer clean-ups, in the average ordinary sense, there is no use for classifiers, jigs, vanners, or what not. If some of the gold is still attached to quartz or other material, grinding alone will release it, and the quantity of material and its value per pound will determine how much expense for grinding and grinding equipment can be permitted. The small arrastra is the cheapest, most ancient and honorable, and probably as efficient as any of the small ball-mills or other fine-grinding apparatus. It can be run by man, mule, or water power and when the entire operation is finished and the camp about to be abandoned, the arrastra can be dismantled and the adjacent soil rocked or panned for the final recovery of almost all the values lost during its use.

I cannot imagine the use of what we commonly call a canvas-table for the saving of gold from such work, as canvas-tables are only suitable for very fine material, 'slimes' in fact, and such fine screening or classification cannot readily be accomplished at a remote placer mine. At any rate, the material should be ground finely before anything else is attempted, and, as it will be possible to amalgamate, in most cases, practically all the recoverable gold while such grinding is being done, why not start out by grinding fine and eliminate the rest of the treatment?

G. L. Holmes.

Jacksonville, California, July 18.

Cyanide Notes

The Editor:

Sir—The very interesting article by Algernon Del Mar, in your issue of June 11, emphasizes an apparent regeneration of cyanide after zinc-dust precipitation. He does not tell us what authorities were available in his library of "major size", but it would seem not to have contained the Transactions of the American and British institutions of mining engineers or of the Society of Chemical Industry or my book on 'Cyanide Practice' (1901), in which I collected my papers.

The subject has received more attention than Mr. Del Mar thinks. In the Transactions of the American Institute of Mining Engineers, Vol. XXVII, p. 283 (see also p. 124 of 'Cyanide Practice'), I point out that the apparent regeneration is apt to arise from the absence of a satisfactory test. "It is well known that the presence of alkali or alkaline carbonates, always present in used solutions, interferes with the silver nitrate test making the solution appear to be stronger in available cyanide than is really the case. Chemists in charge of works should, therefore, be careful not to be misled by this test, or lowered extraction may result. The effect of caustic potash or soda on double cyanide of zinc and potassium is *not* to regenerate all the cyanide of potassium as shown by silver test; the test, as suggested by C. J. Ellis, being rendered unreliable by the silver throwing out the zinc from the double cyanide, and the zinc so displaced being dissolved by the KHO present, thus prolonging the titration."

$$K_2ZnCy_4 + 2AgNO_3 + 4KHO = 2KAgCy_2 + K_2ZnO_2 + 2H_2O$$

That the double cyanide of zinc and potassium in the presence of caustic potash does not split up into simple cyanide plus oxide of zinc and potassium—compare point No. 1 in Mr. Del Mar's penultimate paragraph—was determined by a series of experiments involving the crystallizing out of the products which were analyzed (see p. 129, 'Cyanide Practice'). These experiments proved that the reaction is really $K_2ZnO_2 + 4KCy + 2H_2O = K_2ZnCy_4 + 4KHO$ and not the reverse.

Perhaps the greatest argument against the so-called zinc-box regeneration is stated on p. 147 (same book)—the fact that cyanogen does not appear to accumulate in the sump solutions. Argall gave effective proof of this (p. 148).

Alfred James.

London, June 24.

Concerning Fakes

The Editor:

Sir—We who reside here have noted with considerable interest and silent applause your fearless criticism of George Graham Rice and others of his kind. We all know, if we are honest and candid with ourselves, the irreparable damage such fake-promoters do to the mining industry, particularly to the interests of the legitimate promoter and prospector. We who live here are naturally somewhat used to such concerns as you so justly condemn, but my thought dwells on a question that recurs to me whenever I think of crooked worthless promotions, and that question is how can such a proposition as the Cornucopia Divide Mining Co., the prize fake of the Divide district, an out-and-out wildcat in both properties and management, circulate its "engineer's" reports (these reports were prepared for the "Company" by a local assayer who signs himself M.E. Said M.E. received as a fee some 1000 shares of the stock to act as a 'come on' and assist in swindling his fellowmen). Their "President's" report and "annual" statement are fine, but why can such a concern circulate these fake reports with impunity? and furthermore why should they enjoy the privileges and benefits derived from operating under the sanction and permit of the Commissioner of Corporations of the State of California? The State of Nevada has suffered as no other Western State has suffered from the effects of just such corporations as the Broken Hill and Cornucopia, but this is the first instance I have noted where a permit was asked for

and received by a company of this type. It must have taken monumental nerve to put this across, but it 'worked'. A fake company masquerading as legitimate (especially if having secured a permit) is doubly dangerous to the public and no mercy ought to be shown in turning the spot-light of publicity on such concerns. The public is entitled to such protection as the 'Mining and Scientific Press' affords by publishing the facts.

Tonopah, Nevada, July 18.

E. M. West.

The Value of Gold

The Editor:

Sir—In reading the letter of Mr. Robert B. Brinsmade in your issue of July 31, 1920, which has only now reached me, I am reminded that in this and many other letters and articles dealing with the increased cost of living, increasing wages, and so on, little or no consideration is paid to the problem of how it is to be done. Thus I see in one of your leaders in the same issue you state that $3.34 per day for a miner is not enough. Before the War I take it that in England the daily pay of an average laborer, skilled and unskilled, would be about the value of two grammes of fine gold. This I was under the impression meant that the same amount of labor in one form or another (machinery and tools represent so much labor) was needed to produce two grammes of fine gold. The cost of producing gold must include the costs at the unprofitable gold mines as well as the profitable. I presume that the currency of both America and Europe is still on a gold basis; and if this is so, it is a mystery how a laborer is to receive more than the two grammes of gold per day unless he does more work. Even if all people were paid the same, Cabinet ministers, managers, and laborers, the equal division would not add much to the two grammes. If the gold standard is abandoned, there is no necessary limit to the value labor can demand for its work. But it is a waste of paper. Further, it is robbing all the poor people who had been saving for old age.

Temporarily I am living in a remote district in Sumatra, where there is little money, and nearly all the trade of the natives is done by barter. We who have to use money, have to pay more for local products such as rice, fruits, fowls, and eggs, because, as the sellers explain, they have to pay more for cloth, pots, and pans, and so on. This is quite understandable, and the people who live here and only work for themselves feel no change in conditions. It is not conceivable, however, that in any country one large part of the population, such as the colliers, shall continue indefinitely to be able to demand the equivalent of several days work from another for one day's work by them.

You refer to the bounty on gold. The other day I had to buy some sovereigns, and the Java Bank, which is the National bank for the Netherlands Indies, charged 18 francs each, whereas at the same time they only paid me 10.50 f. per pound for a draft from London!

However, as long as the world is run, as it is, selfishly, and the highest business morality is to buy as cheaply as posible, and sell as dearly, whether it be soap, cloth, or manual labor, there does not seem much chance of solution outside the laws of evolution.

J. Egerton Wood.

Batavia, October 9, 1920.

Measurement of Surface-Tension

The Editor:

Sir—The method of measuring surface-tension attributed to Dr. A. Ferguson and described in the short paragraph on page 124 of your issue of July 23 is known as Jaeger's method, and is one of the well-known methods of measuring this force. A description of the method and an analysis of the mathematics involved is given by Ferguson in the 'Philosophical Magazine', Vol. 28, July 1914, page 128. In the same magazine, Vol. 28, September 1914, page 403, is another article by Ferguson 'On the Surface-Tensions of Liquids in Contact with Different Gases', in which results are given as obtained by the use of this method. In 'Science Progress' of January 1915, Dr. Ferguson, under the caption 'Capillary Constants and their Measurements', gives a critical account of twenty methods for measuring surface-tension, in which Jaeger's method is included.

In practice, Jaeger's method consists in measuring the maximum pressure required to liberate a gas bubble from the end of a vertical capillary tube plunged beneath the surface of the liquid, or in contact with the liquid, the lower end of the capillary being on a line with the level portion of the liquid surface. At the laboratory of the University of Idaho School of Mines, Jaeger's method is used in conjunction with the method of weighing the tension in a bubble film. Surface-tensions have been studied extensively in connection with the investigation of flotation phenomena, and laboratory devices have been made which make the method of weighing the tension in a bubble film a rapid accurate laboratory method for measuring surface-tension. Articles describing the work and apparatus are soon to appear.

In case of pure liquids, results by these two methods are in very close agreement. When a contaminant which changes surface-tension is present in the liquid, results by Jaeger's method are always higher than those obtained by the other method, and this is true whether the contaminant lowers or raises the surface-tension of the solution. The tension of a freshly formed surface of a liquid containing a contaminant, as measured by the film method, is greater than that of an older surface similarly measured, and approaches the tension as measured by Jaeger's method.

In the case of the older surfaces, an approximate equilibrium is established between the surface and the solution; the factors tending to establish this equilibrium are time and agitation without aeration or the passing of bubbles through the solution.

R. B. Elder.

Moscow, Idaho, July 29.

Surface-Energy and Adsorption in Flotation

By A. W. Fahrenwald

Introduction. Theories of flotation have shown little development during recent months. One reason is that most of the possible physical and chemical explanations have been discussed, and nearly every theory advanced has left much wanting. Exact data and measurements have been difficult to collect, owing to the number of variables involved and the difficulties of designing experiments that could tell anything.

By making use of one of the fundamental laws of colloid chemistry it was possible to design a number of experiments from which I have been able to obtain some data on certain previously unanswered questions in flotation.

The purpose of the present paper is to discuss briefly an instrument developed for measuring surface-tension and the way in which it has been applied to the study of flotation. Further work is in progress, but the results so far obtained have proved of such interest that immediate publication of some of them seems justified. Certain reservations are made in the paper pending further experiments.

Flotation is a process involving the physics of surface-energy, including adsorption, and it appears that a study of these phenomena is indispensable to a solution of the problem.

The interfacial tension theory of flotation is now generally accepted. It was first suggested by O. C. Ralston,[1] who applied the inequalities of Reinders. These inequalities were further applied to explain flotation by Taggart and Beach,[2] by Taggart'[3], by Corliss and Perkins,[4], and more recently by Frederick G. Moses.[5]

In the present paper a preliminary quantitative study of certain surface-energy and adsorption phenomena has been made for the purpose of learning, if possible, exactly what takes place in a flotation pulp.

Adsorption. It is well known (1) that solids adsorb or hold closely to their surfaces certain gases, liquids, and molecules or even ions; (2) that liquids adsorb or hold closely to their surfaces gases, liquid globules, small solid particles, molecules and ions of solutes. More strictly speaking, the adsorption or concentration (generally of a third substance) is at the interfacial layer separating two phases. For example, water in contact with air gives an air-water interface; a certain tension exists at this interface which is spoken of as the water-air interfacial tension and is measurable to a high degree of accuracy. Many substances in the water phase go readily into this interface, that is, they concentrate there, and this surface concentration process is called 'adsorption'. Soaps, flotation-oils, and many other substances dissolved or suspended as small particles in water concentrate in the water-air interface. If water is in contact with a solid such as the walls of a glass tumbler, a water-solid interface exists and it is presumed that a tension exists at this interface, although methods are not available for measuring it. If solid particles are suspended in water, a liquid-solid interface exists as truly as in the case of the water against the tumbler. Certain third substances in the water, in solution or in mechanical suspension, as oils and colloids, may concentrate in this solid-water interfacial layer, as shown later in this paper.

The interfacial tension between two phases, such as water-air, and water-solid, is a definite and specific quantity, and it is different for different substances in contact, and is affected (lowered) in many cases by the presence of a third substance in one or both of the phases.

It is an accepted generality that if the surface-tension or surface-energy of water or any other liquid is lowered, a surface concentration of a third substance has taken place, and, inversely, if a third substance has been adsorbed or concentrated at the surface of a liquid, the surface-tension or surface-energy has been reduced.

Willard Gibbs early worked out the mathematical relationship involved in the above general principle. His simplest equation appears in the form:

$$U = -\frac{c}{RT}\frac{ds}{dc}$$

where U is excess concentration at the boundary surface in grammes per centimetre, c is the concentration of solute in bulk of solution, R is the constant of the simple gas equation, T is the absolute thermodynamic temperature, and s is the interfacial tension. As this expression shows, any substance that lowers the surface or interfacial tension will concentrate at the interface, whereas any substance that raises the tension will be driven out from the interface. This expression has been investigated in several cases and has been found to hold. The formula, however, is of little value because interfacial tensions like that between a solid and a liquid cannot be determined experimentally. But it will be shown later in this paper that undoubtedly adsorption of at least certain constituents of flotation-oils takes place at the surface of certain minerals. Although in the experiments that follow it makes little difference, it is reasonable to suppose that when oil is adsorbed at the surface of solid par-

[1] 'Why do Minerals Float?' 'M. & S. P.', Vol. 111, pp. 623-627, 1915.

[2] 'An Explanation of the Flotation Process', Trans. A. I. M. E., Vol. LV, pp. 547-562, 1916.

[3] Franklin Inst., Vol. 178, pp. 485-498, 1920.

[4] 'The Theory of Flotation', H. P. Corliss and C. L. Perkins, 'Jour. Ind. Chem.', Vol. 9, pp. 481-488, 1917.

[5] 'Surface Energies in Flotation', 'E. & M. J.', Vol. 111, pp. 7-11, 1921.

ticles, both the oil and solids being suspended in water, there is a lowering of the water-solid interfacial tension.

It was the above important principle that suggested the line of investigation outlined in this paper. It is significant to point out that most flotation-oils lower the surface-tension of water, that is, they contain certain constituents or group molecules that do so. *If it happens that the third substance added to a water-solid system is adsorbed at both the water-air and water-solid interfaces, surface-tension measurement on the water should give a scheme for determining the amount of the third substance adsorbed by a unit of surface of the solid phase.* In the experiments that follow later in this paper, it will be seen that flotation-oils (or certain of their constituents) when agitated in water lower its surface-tension. A curve can be plotted giving surface-tension on the vertical ordinate, and oil-water concentration on the horizontal ordinate. It will be presumed that such a curve can be used to determine approximately the amount of a given oil in water; then, by simply measuring the surface-tension of a given oil-water mixture and referring to the curve the amount of oil in the water can be told at once. Any oil, or certain constituents of it, removed from the water by any means, can be detected by measuring the surface-tension of the mixture. This presumption is made the basis for determining the amount of a given oil that is adsorbed from a given oil-water mixture by a unit of a given mineral surface.

Surface-tension is a manifestation of an intermolecular force, whether it be due to the electro-magnetic fields surrounding the molecules (Langmuir[6]) or to some other bonding power is not an essential distinction in the theory that follows.

By definition the surface-tension of a liquid is the amount of force required to rupture a film of that liquid one centimetre wide. This force is generally expressed in dynes. For water and other liquids this value[7] is slightly affected by the nature of the gas in contact with the liquid film.

The surface-tension of water and oil-water mixtures is such a fundamentally important factor in flotation that it is desirable to have accurate and rapid methods for measuring it. It has been determined by Richards and Coombs[8] to be 72.62 dynes per centimetre at 20°C.; by Harkins and Brown[9] to be 72.8 dynes per centimetre at 20°C., and by many others. Of these measurements, those of Harkins and Brown are perhaps the most accurate, as every precaution was taken in selecting capillary tubes for the determinations and in making the tests. A variety of methods, of which the most important are the drop-weight, capillary tube, capillary plate-disc, and vertical-jet, has given values for the surface-tension of water that vary from 72 to 82 dynes per centimetre. The well-known drop-weight method in the hands of the ordinary operator is not accurate,[10] and requires a great deal of time in making the measurement. For the rapid and accurate surface-tension determinations of oils and water required in the present investigations none of the above methods is feasible.

Measurement of Surface-Tension. The following apparatus, designed by me, embodies the principles of the apparatus used by Elder,[11] Ferguson,[12], and Bhatnagar,[13] and of the method described by Watson.[14] With this instrument (Fig. 1) the surface-tension of a liquid is determined by measuring the pull required to rupture a film of that liquid of known width. Instead of using a Jolly balance for measuring the tension, as was done by Elder, Bhatnagar, and others, a direct-reading springless balance is used, and instead of using a sphere or a disc to engage the liquid film, a bar or knife-edge of suitable length and design is used. A detailed description follows:

Referring to Fig. 1, it is seen that the apparatus consists of a ring-stand to which is attached near its top a ring *A* suitably machined and provided with small grooves *B* to form bearings for the knife-edge of a swinging member. The latter consists of a 2½-in. cork *C*, an axis *D* machined at either end to knife-edges passing axially through the cork engaging the bearings *B*, and a pointer *E* of suitable length stuck into the edge of the cork wheel nearly perpendicular to its axis. The pointer *E* serves as a suitable weight to be lifted in breaking the film of which the tension is to be determined.

The upright rod, comprising a part of the ring-stand, is threaded for about three inches at its lower end and fitted with a small hand-wheel *F*. The latter may be raised or lowered, and in turn raises or lowers the sleeves *G* and the attached ring *H*. This second ring serves as a support for the watch-glass *J* containing the liquid to be tested.

A scale *S*, placed back if the swinging pointer *E*, is so graduated that each space represents the same horizontal travel of the centre of gravity of the pointer. This scale may be standardized to read surface-tensions on the scale directly in terms of dynes per centimetre.

The cork wheel *C* mentioned above is provided with a small peripheral groove. Over the cork and in this

[6]'The Constitution of Liquids with Especial Reference to Surface-Tension Phenomena', 'Met. & Chem. Eng.', Vol. 15, pp. 468-470, 1916.

[7]Ferguson, 'Phil. Mag.', Vol. 28, pp. 403-12, 1914; Bhatnagar, 'Jour. Phys. Chem.', Vol. 24, pp. 716-737, 1920.

[8]Jour. Am. Chem. Soc., Vol. 41, pp. 499-524, 1919.

[9]Jour. Am. Chem. Soc., Vol. 41, pp. 499-524, 1919.

[10]F. L. Perrot ('Jour. Chem. Phys.', Vol. 15, pp. 164-207, 1917) concludes that the classic formula $P = 2\pi ry$, which shows the proportionality between surface-tension and drop weight, should be definitely abandoned; it is only an erroneous approximation. He further states: "A relation which gives the drop weight as a function of the other properties of the liquid is still to be found."

[11]'Interfacial Tension Measurements and Some Applications to Flotation', Pamphlet No. 1, by Idaho State Bureau of Mines & Geology.

[12]'Phil. Mag.', Vol. 26, pp. 925-34, 1914.

[13]'The Effect of Adsorbed Gases on the Surface-Tension of Water', 'Jour. Phys. Chem.', Vol. 24, pp. 716-735, 1920.

[14]'A Text-Book of Physics', Longmans, Green & Co., 1905, p. 192.

groove is hung a No. 50 white cotton thread, to the end of which is suspended an aluminum or silver bar K about eight inches below the axis of C, and to the other end of which thread is hung a counter-weight. The purpose of the bar K is to engage the liquid to be tested; it is described more fully below.

A surface-tension bar six centimetres long is suitable. The small horns L (shown in Fig. 2) are to prevent the film of liquid from pulling away from the ends of the bar, as would be the case if the horns were not provided. They are made sufficiently thin and narrow to be quite

FIG. 1. INSTRUMENT FOR MEASURING SURFACE-TENSION

FIG. 1A. ANOTHER VIEW OF THE SAME

negligible, the length of the bar being taken as the length of the straight edge between the horns.

If now the watch-glass containing the liquid to be tested is raised by means of the hand-wheel F until the liquid engages the horizontal edge of the bar K and is then slowly lowered (see Fig. 1A) the liquid will adhere to the bar, and a bubble film will be drawn out. The tension existing in this film will exert a pull on bar K and is measured by reading the number of divisions on the scale through which the pointer has been swung.

It is important to note that in making a determination of surface-tension, two breaking-points, a maximum and a constant reading, will be observed. The first breaking, represented in Fig. 3, will swing the pointer approximately up to the 80 to 85-dyne graduation in the case of water, depending on the thickness of the bar-edge; for a knife-edge the difference is about two dynes. Then, as the liquid being tested is lowered further, a liquid film will be drawn out (Fig. 4) and the pointer will drop to a constant reading, representing the true tension between the 74 and 75-dyne graduations. The conditions of the two readings are shown in Fig. 3 and 4.

The first breaking or slip does not represent the true breaking-tension of the liquid film unless the body of liquid raised above the surface of the liquid is taken into account and corrected for. This involves the use of a somewhat complicated and cumbersome equation.[15] For water without any correction, it gives approximately 76 dynes per centimetre for an edge 0.015 cm. wide. It will vary greatly from this figure, depending on the thickness of the knife-edge engaging the liquid and the degree of wetting of the metal edge by the liquid. If, after careful treatment[16] of the knife-edge so that it will be completely wetted by water, several measurements of the tension required for the first breaking are made in succession, it will be found that tension as measured decreases gradually. This is due to the fact that the degree of wetting of the knife-edge by the water decreases; in other words, the liquid-metal contact angle increases from probably zero to several degrees, and the total

[15] 'Phil. Mag.', Vol. 26, pp. 925-34, 1914.

[16] I have found that the best way to treat the silver plate or knife-edge to ensure perfect wetting is by rubbing it between the thumb and finger with a little bone-ash and then rinsing it under a running tap.

breaking-pull decreases as the contact-angle increases. It was also found that in the several determinations the point at which the pointer came to rest for the second reading was constant.

This method has the advantage over others of greater accuracy, due to the fact that the force required to break a straight film several centimetres wide is measured instead of the tension exerted by a width of less than one centimetre, measured around a circular section of a drop, as in the drop-weight method. The accuracy is also in-

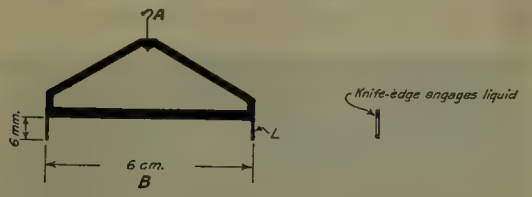


FIG. 2

dependent of absolute wetting of the surface-tension bar by the liquid to be tested, as pointed out above. This is not true of other methods, which are dependent on absolute wetting of the disc, capillary tube, or surface engaging the liquid, and therefore are unreliable and more or less impracticable. The method has the further advantage that a determination can be made in a few seconds, as it is read directly from the graduated scale.

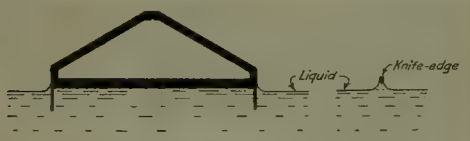


FIG. 3

An absolute or theoretical measurement is made by the use of the following equation:

$$ST = \frac{W981}{2L}$$

where ST is the surface-tension in dynes per centimetre, W is the weight in grammes producing the same deflection of the pointer as the breaking-stress of the unknown liquid film; 981[17] is the equivalent in dynes of one gramme, and L is the width of the film ruptured. By the method as above described the surface-tension of water has been determined to be 72.85 dynes at 20°C. This value is in close agreement with the most accurate figures obtained to date, which would seem to indicate that the instrument and method are accurate. It should be pointed out that in a measurement of surface-tension by means of the above described instrument, correction should be made for the pull of the liquid acting on the horns L, as they are actually projecting into the liquid at the time the tension of the film is being measured. One method of doing this is by bringing the dish containing the liquid up to the horns until they just dip into it. The dynes deflection of the pointer is deducted from the previous reading, which represents the film-tension plus the liquid-tension pulling down the horns. Another factor, apparently entirely negligible, is the weight of the liquid film, which presumably is of the order of the thickness of a bubble film.

CONTAMINANTS IN FLOTATION. That certain contaminants are detrimental to flotation is well known, but the cause of their deleterious effect is an interesting problem. One interesting case that has been studied with the aid of my tensimeter is the case of a common flotation-oil on water (see Fig. 5). If we place on the surface

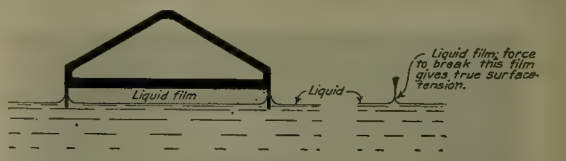


FIG. 4

of clean water a drop of No. 1. Cleveland Cliffs hardwood-creosote oil, it immediately spreads and covers the surface of the water with an oil film presumably one molecule thick. The excess of oil over and above the quantity required to just cover the surface of the water collects into lenticular globules. Now we say qualitatively that the oil spreads if

$$T_{w\,a} > T_{o\,w} + T_{o\,a}$$

where $T_{w\,a}$, $T_{o\,w}$, $T_{o\,a}$ are, respectively, the water-air,

FIG. 5

oil-water, and oil-air interfacial tensions. In this particular case, at the instant the oil touches the water and before spreading takes place, $T_{w\,a} = 72.8$,[18] $T_{o\,w} = 5$, and $T_{o\,a} = 32.5$ dynes per centimetre. It can be shown by actual measurement that the addition of one drop of soap solution to the water in a 200-cc. beaker before the oil is introduced will prevent the spreading of the oil. The soap alone lowers the surface-tension of the water to 30 dynes, which is less than $T_{o\,w} + T_{o\,a}$ and the oil therefore does not spread but forms in a mass of the shape shown in Fig. 5. In a similar manner the above oil lowers the surface-tension of the water by spreading to less than $T_{o\,w} + T_{o\,a}$, and the excess of oil collects in lenticular globules as when the soap solution has been added. Many other substances prevent oil from spreading readily on water, and if they are not flotation agents themselves, they are deleterious to flotation. *One of the characteristics of a flotation agent is that it generally, and probably must, lower the surface-tension or surficial energy of water.*

[17] This value varies slightly with altitude, but does not affect the value of a reading for any particular locality even in the third decimal place.

[18] Although the theoretical measurement of water by the method above described was given as 72.85 dynes, 72.8 is used throughout the rest of the text, as direct readings can be estimated to tenths only, and all other readings are made direct.

A film of General Naval Stores No. 5 steam-distilled pine-oil on water gives the latter a surface-tension of 48 dynes, and a film of Cleveland Cliffs Iron Company hardwood-creosote No. 1 lowers it to 45.5 dynes. The poorest kind of flotation would result if all the bubbles in an ore-pulp had a surface-tension as low as this. Much gangue would float under this condition of extremely low surficial energy.[19] The following table gives the surface-tension of a few flotation-oils as determined with the tensimeter described above.

Surface-Tension of Flotation-Oils

	Dynes per cm. at 15°C.
Pine-oil	29.0
Refined pine-oil	32.0
Crude wood-creosote	35.5
Resin oil	41.0
Re-distilled tar-oil	38.0
Crude wood-turpentine	32.0
Tar-oil	40.0
Hardwood-creosote	32.5
Coal-tar creosote	39.5
Pine-oil (steam-distilled)	33.2

EMULSIONS IN FLOTATION. An emulsion is defined by W. Clayton[20] as "a heterogeneous system in which a liquid is dispersed as droplets in some other liquid with which it is only partly or not at all miscible". Theoretically two types of emulsions may exist, according to which liquid is dispersed as drops. It is not definitely known whether the agitation of flotation-oils in water produces an emulsion of oil in water or one of water in oil. Emulsions of pine and hardwood oils with water have surface-tensions much lower than that of pure water. The following table gives the surface-tensions of emulsions of three well-known flotation oils with water.

Surface-Tension of Oil-Water Emulsions

Distilled water cc.	Drops number	Oil weight mg.	Surface-tension dynes per cm. at 17°C.
100	0	0.0	72.8 at 20°C.
Hardwood-Creosote Oil—Cleveland Cliffs No. 1			
100	1	8.86	59.0
100	2	17.72	51.5
100	3	26.58	48.5
100	4	35.44	45.5
100	5	44.30	45.5
Pine-Oil—Hunter Johnson Co., No. 259			
100	1	8.8	65.0
100	2	17.6	57.0
100	3	26.4	50.0
100	4	35.2	48.2
100	5	44.0	48.2
Coal-Tar Creosote—Barrett Co., No. 2			
100	1	15.0	67.5
100	2	30.0	66.5
100	3	45.0	65.5
100	4	60.0	65.0
100	5	75.0	65.0

[19]Every operator well knows what happens when more than a certain small amount of oil is added to the ore pulp to be floated. Large quantities of gangue-minerals immediately make their appearance in the froth-concentrate.

[20]'The Modern Conception of Emulsions', Jour. Soc. Chem. Ind., Vol. 38, May 31, 1919.

The above data are plotted in the graph, Fig. 6.

It is seen that the surface-tension of the water decreases rapidly with addition of oil up to a certain concentration of oil, when the curve flattens out. It is probable that at this point the amount of oil adsorbed at the surface of the water has reached that of a complete film of oil. The lower concentrations correspond approximately to the quantities of oil used in flotation practice.

The surficial energy of an oil emulsion may be increased by aeration and skimming[21] of the surface as the bubbles burst, a portion of the oil being removed by surface concentration or adsorption at the water-air (bubble) interface. Other substances in the water may, however, interfere with this process. An oil or other agent that cannot be thus removed is, from the point of

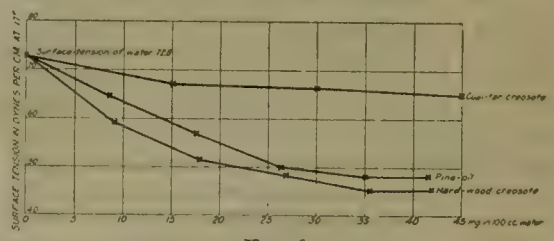


FIG. 6

view of this theory, a poor flotation agent. *The soluble oil and oil droplets may likewise be removed by agitating the emulsion with certain minerals such as sulphides.*

THE TESTS. Emulsions were prepared by agitation of the oil with 100 to 200 cc. of water. A motor-driven soda-fountain drink-mixer was used as agitator, in most cases considerable foam being produced by the agitation. Any surface-tension measurement made on the emulsion before all the foam had disappeared was not reeliable, and before check measurements could be obtained it was necessary, after the dissipation of the foam, to pour the emulsion back and forth several times from one beaker to another. Several measurements were made on each emulsion, observing between each measurement the precaution of pouring back the part tested into the original beaker, and taking a new portion from the whole.

When several emulsions of the same oil-concentration and surface-tension were required, 400 to 600 cc. of water were taken, and, after agitating in the required weight (in. mg.) of oil, they were divided into volumes of 100 cc. each, and poured back and forth into each other several times. It was found that this was the only procedure that would give several emulsions of the same surface-tension.

Before treating the emulsion with any mineral, the mineral particles were agitated with clean water in order

[21]Mr. Elder of the Idaho State Bureau of Mines & Geology has applied this principle to the treatment of slime-tailing from the Coeur d'Alene. He has removed contaminants from the slime that tend to lower the surface-tension of water and has thereby increased the power of the oil to spread on the watery ore-pulp. For details the reader is referred to Pamphlet No. 1 of the Idaho Bureau of Mines & Geology, Moscow, Idaho.

to remove any powdered mineral held at the surfaces of the particles, and to ensure complete wetting by the water. A given number of cubic centimetres of the particles were then stirred or agitated in the emulsion or allowed to fall through it for a specified length of time; one minute being the standard, unless otherwise stated. The same precautions were taken in measuring the surface-tensions of the emulsions before and after treatment.

MINERAL-OIL ADSORPTION. Not all minerals will adsorb oil, and those that adsorb little or none are not easily floatable. The surfaces of sulphide mineral particles adsorb oil from oil-water emulsions quite readily. The amount adsorbed can be estimated by measuring the surface-tension of the emulsion before and after treatment with a given quantity of mineral particles of known size. If we treat a series of emulsions of known oil-concentration and of determined surface-tension with a given quantity of mineral particles of known size and determine the surface-tension of the emulsions after treatment, it is possible to estimate the quantity of oil, or at least the constituents that lower the surface-tension of water, adsorbed by a unit surface of the mineral. The quantity and rate of adsorption are possibly a measure of the floatability of the particular mineral. However, different minerals may adsorb different constituents or group-molecules of the oil. The following table gives the surface-tensions of a series of emulsions of varying oil-concentrations before and after treatment with a given amount of clean galena.

with galena is evidence that the oil, or certain constituents that lower the surface-tension, has been removed from the water, and made unavailable for the purpose.

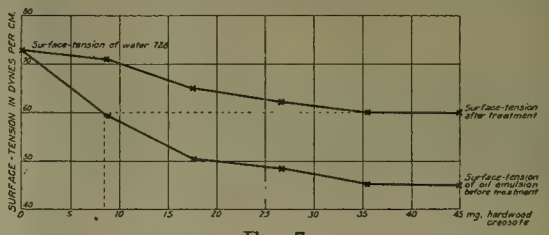

SURFACE-TENSION IN DYNES PER CM.
Surface-tension of water 72.8
Surface-tension after treatment
Surface-tension of oil emulsion before treatment
mg. hardwood creosote

FIG. 7

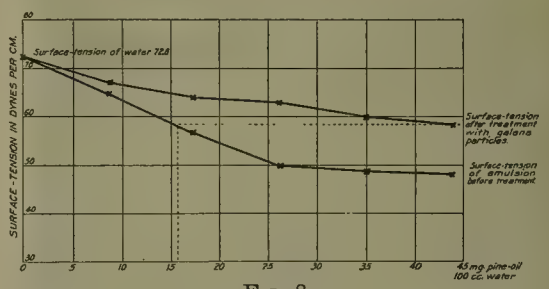

SURFACE-TENSION IN DYNES PER CM.
Surface-tension of water 72.8
Surface-tension after treatment with galena particles
Surface-tension of emulsion before treatment
45 mg. pine-oil 100 cc. water

FIG. 8

In the case of the hardwood-creosote the 50 gm. of galena used has adsorbed nearly 80% of the five drops of oil added. This indicates that the hardwood-oil is more readily adsorbed by the galena than is the pine-oil. It

Surface-Tension of Oil-Water Emulsions Before and After Agitation with 50 Gm. (–10 +20-Mesh) Galena Particles

Distilled water	Oil		Surface-tension at 17°C. dynes per cm.		Oil adsorbed per unit (sq. cm.) of mineral surface	Oil per 100 cc. of residual solution	Percentage of total oil adsorbed
cc.	drops	weight mg.	before treatment	after treatment	mg.	mg.	%
100	0	0.0	72.8	71.0	0.0234	1.30	88.18
			Hardwood-Creosote				
100	1	8.86	59.0				
100	2	17.72	51.5	65.0	0.0390	5.50	72.00
100	3	26.58	48.5	62.0	0.0622	6.70	74.5
100	4	35.44	45.5	60.0	0.1100	9.0	74.5
100	5	44.30	45.5	60.0	0.1110	9.0	80.0
			Pine-Oil				
100	1	8.8	65.0	67.0	0.0075	6.3	71.8
100	2	17.6	57.0	64.0	0.0250	9.6	54.3
100	3	26.4	50.0	63.0	0.0483	10.9	41.1
100	4	35.2	48.2	60.0	0.0950	14.2	40.0
100	5	44.0	48.2	58.5	0.0980	15.0	34.0

Calculation of approximate total mineral surface in 50 gm. (–10 +20-mesh) galena.
Average diameter of particles = 1.21 mm.
Weight of mineral particle = $1.21^3 \times 7.5$ (sp. gr. of galena) = 13.3 mg.
Number of particles in 50 gm. = 50,000 ÷ 13.3 = 3650.
Total surface of mineral = $1.21^2 \times 6 \times 3650$ = 32,000 sq. mm. = 320 sq. cm.

These data are plotted in the graphs, Fig. 7 and 8, from which it is possible to calculate the total amount of oil in milligrammes adsorbed per square centimetre of surficial galena surface treated. In the case of the pine-oil more than three (30 mg.) drops of the five used (49 mg.) were adsorbed by the mineral. The fact that the surface-tensions of the emulsions have been raised by treatment has been found in practice in the Coeur d'Alene region that Cleveland Cliffs hardwood-creosote is one of the best oils for floating galena.

In another test two emulsions of identical oil-concentration (24 mg. in 100 cc. water) and surface-tension (by measurement) were treated respectively with 10 cc. of –20 +28-mesh galena from the Coeur d'Alene, and with

10 cc. of −20 +28-mesh galena from California. Each mineral-emulsion mixture was agitated one minute. The surface-tensions of the emulsions after treatment were 68.5 and 69.5 dynes respectively in contrast to 50 dynes for the untreated emulsions. From this experiment it appears, if we assume the same amount of surface was exposed to treatment in both cases, that samples of galena from different districts have slightly different adsorptive powers; it is to be expected that the Californian galena, which adsorbed more oil than that from the Coeur d'Alene, would be more floatative We know from experience that apparently similar minerals seemingly do vary in degree of floatativeness, although frequently the difference in behavior is due to difference in the gangue.

The Relative Floatability of Sulphides. It is well known from experience that all sulphide minerals are not equally floatative under given conditions. If adsorption and floatativeness are in any way related, it should be possible to establish this relation by determining the relative adsorptive capacities of different sulphides under given conditions. To test this the following experiment was made.

Five oil-water emulsions containing the same amount of oil (approximately 25 mg. hardwood-creosote) and having the same surface-tension (by measurement), namely 49 dynes, were prepared. These were treated with 8 cc. of −20 +28-mesh particles of the following minerals:

No. 1 emulsion was treated with galena from the Coeur d'Alene.

No. 2 emulsion was treated with sphalerite from Missouri.

No. 3 emulsion was treated with chalcopyrite from Globe, Arizona.

No. 4 emulsion was treated with chalcocite from Butte, Montana.

No. 5 emulsion was treated with clean quartz.

The surface-tensions of the emulsions after treatment were respectively as follows: 56.5, 52.0, 54.0, 54.5, and 50 dynes. These data are plotted in Fig. 9.

This experiment demonstrates clearly that under a given condition different sulphides have different adsorptive capacities for flotation-oils, and that there is a close relation between adsorptive power and floatability. It has been my experience that the relative floatative properties of the above minerals are in the same relative order as the adsorptive powers shown above. Further, there is at least a coincident relation between the adsorptive powers of minerals and their molecular weights. Of the above sulphide minerals, galena has both the highest molecular weight and the highest adsorptive power. Sphalerite has the lowest molecular weight and is seen to have the least adsorptive power. Of course, this may only be a coincidence. Quartz, of course, is not a floatable mineral, and its power to adsorb oil is seen to be very small; it has raised the surface-tension of the emulsion only one dyne.

Adsorption and Size of Mineral Particle. If minerals adsorb oil, as the above tests show conclusively, the quantity adsorbed should be in proportion to the total amount of mineral surface exposed. To test this premise the following experiment was made: Four emulsions, each containing four drops (23 mg.) of No. 1 Cleveland Cliffs oil in 100 cc. of water were made up. Each had a surface-tension of 50 dynes by determination. One of these was treated with 6 cc. of galena particles passed through a 14-mesh screen and remaining on a 20-mesh screen, one with 6 cc. of −20 +28-mesh galena particles, one with 6 cc. of −28 +35-mesh galena, and one with 6 cc.

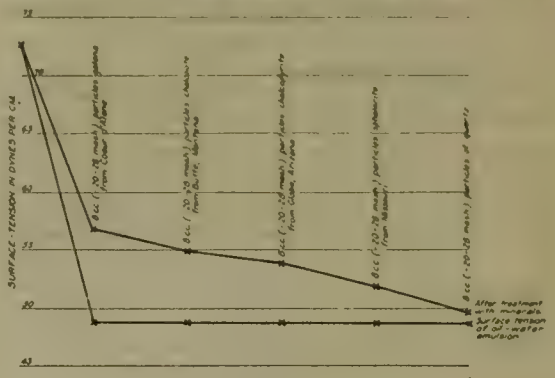


Fig. 9

of −35 +48-mesh galena. The surface-tensions of the emulsions after treatment were respectively as follows: 51.0, 53.0, 54.3, and 57 dynes. The total milligrammes of

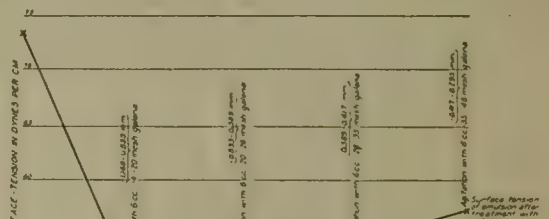


Fig. 10

oil adsorbed is 3.06, 6.12, 7.65, and 10.75 respectively. The amount of oil adsorbed per unit of surface is 0.091, 0.118, 0.113, and 0.068 mg. per square centimetre respectively. This is a reasonably close check when it is considered that quantity of oil adsorbed is a function of mineral surface and oil concentration, as seen in the table that is given in Fig. 10. This experiment indicates clearly that the amount of oil adsorbed increases as the amount of mineral surface increases. This is perfectly natural and serves as a reliable check on these experiments. In flotation it is therefore to be inferred that the amount of oil used should be in proportion to the size of the mineral particles to be floated, to the percentage of floatable mineral surface, the contents in the ore, and the amount of water used in the pulp.

Temperature and Adsorption. Ore-pulps to be treated by flotation have in practice been heated before treatment in several instances. To determine if adsorption of oil

by mineral is affected by temperature, the following experiment was made: Three emulsions of hardwood-creosote oil in water were made up, each contained 22 mg. of oil and had a surface-tension of 50.7 dynes. No. 1 emulsion was treated with 6 cc. of (–20 +28-mesh) galena particles at 20°C., and No. 2 with 6 cc. (–20 +28-mesh) galena particles at 50°C., and No. 3 was run as a blank under the same condition as No. 2, but without the galena. The object in running the blank was to be sure that the heating and cooling of the emulsion was not the factor affecting the surface-tension, since the measurements were all made when the emulsions were at the temperature (20°C.) of the room.

The surface-tensions of the three emulsions after treatment were 53.7, 57.0, and 51.0 respectively. At the room temperature (20°C.) the surface-tension of the emulsion was raised, through treatment with the mineral, from 50.7 to 53.7 dynes, an increase of 3 dynes, or, from curve Fig. 6, equivalent to an adsorption of approximately 7 mg. of oil. At 50°C. the surface-tension of the emulsion was raised from 50.7 to 57.0 dynes, an increase of 6.3 dynes, or equivalent to an adsorption of approximately 11 mg. of oil. The blank test after treatment had a surface-tension of 51.0 dynes, approximately that of the original emulsion, 50.7 dynes, indicating that the heating operation hardly affected its surface-tension. The same temperature increased the adsorptive capacity of chalcocite (Cu_2S) for the same oil over 50%. It would appear from this experiment that temperature is an important factor in flotation. It will probably be found that certain chemicals likewise affect the adsorptive capacity of given minerals for given oils. Experiments along this line are contemplated.

Adsorption and Air-Bubbles. That air-bubbles in agitation and mixing of oils with ore-pulp are beneficial in practice is well known. To test this point two emulsions, each having a surface-tension of 48 dynes, by measurement, were treated as follows: No. 1 emulsion in a 100 cc. graduate was treated with 6 cc. of (–20 +28-mesh) galena. The graduate was stoppered with a cork that fitted close to the liquid, thus leaving no air space between the liquid and the cork. No. 2 emulsion in a 100 cc. graduate was treated with 6 cc. of (–20 +28-mesh) galena. The graduate was stoppered so that about one inch of air space was left between the liquid and the cork. In each case the graduate was inverted 24 times, that is, the particles of mineral dropped through the emulsion 24 times. In the first case no air-bubbles were present, in the second case numerous small bubbles rushed up through the emulsion as the mineral particles dropped through the emulsion. The surface-tensions after treatment were 52.0 and 54.2 dynes respectively. This result is easy to explain. When air-bubbles are present in the emulsion, a water-air surface is provided at which oil is concentrated; the particles cut through these bubbles, and as a result there is a better contact of mineral with oil than when no bubbles are present.

Surface-Tension of Bubbles in a Pulp. While it is readily possible to measure the surface-tension of oiled pulp entering a machine, and of the tailing leaving the machine, it would be a little difficult to say just what is the surface-tension or the water-air (bubble) interfacial tension of a bubble in the pulp during flotation. As thousands and thousands of bubbles are introduced into the pulp, the surface available for spreading of the oil increases enormously and it is doubtless true that where only a fraction of a pound of oil is used per ton of ore treated, there would not be sufficient oil to lower the surface-tension of the many bubbles very greatly, at least not to the extent that the surface-tension of a beaker full of the pulp containing no bubbles would be lowered; therefore a measure of the surface-tension of the pulp entering the machine would not be a criterion of the surface-tension of the pulp-air bubble, and the pulp-bubble interfacial tension is no doubt higher than can actually be measured.

Summary and Conclusions. The fact that adsorption of oil at a water surface is accompanied by a lowering of the surface-tension or surficial energy of the water has been made the basis for determining the amount of an oil or oil constituent that is adsorbed by a unit of mineral surface. Almost all flotation-oils lower the surface-tension of water with the oil content. For any particular oil a surface-tension oil-water concentration curve can be made; then from a surface-tension determination of water containing a particular oil the amount of oil in the water can be ascertained approximately. It will, therefore, be evident that if an emulsion or mixture of a given oil in water and of a given surface-tension be treated with a specified size and number of particles of a given mineral, and the surface-tension of the oil-water mixture measured again after treatment, the amount of oil adsorbed by a unit surface of any mineral can be determined.

Probably only certain constituents or molecules of the oil are active in lowering the surface-tension of water, and probably only certain constituents are adsorbed at the surface of the mineral, and the method therefore may give only a rough estimate of the amount of oil adsorbed. This is being made the subject of further investigation.

To carry out an investigation where numerous measurements of surface-tension had to be made, it was necessary to develop an instrument with which accurate and rapid measurements could be made. The instrument described above, in the hands of a trained operator, is capable of giving accurate results, and a measurement can be made in less than one minute.

Acknowledgements. I wish to acknowledge my indebtedness in this work to Robert B. Elder of the School of Mines, University of Idaho; for the many ideas and suggestions that have come to me through discussion of the problem with Mr. Elder; to Francis A. Thomson, the Dean of the School of Mines, and Director of the Idaho State Bureau of Mines & Geology, for his early appreciation of the significance of the possibilities of the method of study herein described; and to A. M. Piper, of the State Bureau of Mines & Geology, for his careful scrutiny of this paper.

SURPLUS OF REFINED COPPER NOW ABOUT 728,000,000 LB.—CURRENT OUTPUT 34,000,000 LB. MONTHLY

W. F. Bartholomew, of Tucker, Bartholomew & Co., says of the status of copper: "There is no use disguising the fact that stocks of copper are not being reduced as rapidly as was expected when the leading copper producers shut-down their properties. There is available in this country 728,000,000 lb. of refined copper and if we include stocks in the refineries still in process the total surplus of copper will figure up close to the billion mark. Even this, however, is a reduction of 200,000,000 lb. since the first of the year, but we are only just beginning to feel the effects of the shut-down of the mines. Consumption of copper in this country last year was in excess of 1,250,000,000 lb., but consumption in the United States this year will do well if it amounts to one-half of last year's total. Stocks have not been much reduced the last few months because of the large refinery production, but at the present time only eight properties are now producing, the rate of output being 34,000,000 lb. per month.

"Mines in the United States are now down to 11% of normal production, while South American properties are operating at 46%. Accordingly little matte is now coming to refineries and a steady reduction in stocks should be apparent from now on. A monthly production of 34,000,000 lb. is making the market, for the companies producing this copper are selling it as fast as produced, and while the big selling agencies are not forcing sales the small independent producers are selling at 12¼c. In view of this situation, one must take an optimistic view of conditions, for within the next year there should be a demand for every pound of copper above ground in addition to that which the present producers are turning out; when the future is sufficiently clear for the big companies to resume operations it will take six months for their copper in volume to reach the market."

TEXT OF THE CLAIM-ASSESSMENT ACT

Following is the exact text of the bill of Representative Carl Hayden of Arizona providing for the changing of the 'assessment' year for mining claims:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 2 of "An Act to amend sections 2324 and 2325 of the Revised Statutes of the United States concerning mineral lands," approved January 22, 1880, he, and the same is hereby, amended to read as follows:

"Sec. 2. That section 2324 of the Revised Statutes of the United States be amended by adding the following words: 'Provided, That the period within which the work required to be done annually on all unpatented mineral claims located since May 10, 1872, including such claims in the Territory of Alaska, shall commence at 12 o'clock meridian on the 1st day of July succeeding the date of location of such claims: Provided further, That on all such valid existing claims the annual period ending December 31, 1921, shall continue to 12 o'clock meridian July 1, 1922.'" The bill was passed by the House of Representatives on August 1 and is expected to pass the Senate at an early date.

HOISTING ENGINEERS AT TONOPAH VOTE TO END STRIKE

The strike of the hoisting engineers at Tonopah, in effect since April 16 when the engineers' union refused to accept a daily wage of $5.75, a reduction of 75c. from that previously in effect, was ended on August 5 by a vote of the engineers.

It is reported that the vote was thirteen for, and six against, resumption of work under the new wage. Every former employee will find employment, it is stated, as the Tonopah Mining Co. made no effort to fill vacancies caused by the strike on April 16, either in its mine or mill, and other mines awaiting forces are the Rescue Eula, Midway, Monarch, Jim Butler, California, Brougher, Gold Zone, and Klondyke leases. The West End is the only large mine of the district that refused to combine in the reduction of wages ordered almost four months ago and is still paying the old scale.

Under the scale of wages ordered by the operators in the spring, machine-men in the mines receive $5.25 per day and shovelers $4.75. In the mill conveyorman, filter operator, mill laborer, oiler, pipe-fitter's helper, and solution-helper get $4.75; crusherman, batteryman, repair man, fireman, pipe-fitter, refineryman, solution-man, tableman, and tube-mill man receive $5.25. It is believed that the other organizations will follow the lead of the hoisting engineers in declaring the strike off.

NEW RAILROAD FROM ROGERSON, IDAHO, TO WELLS, NEVADA

The Interstate Commerce Commission at Washington, D. C., has issued a Certificate of Permit for the construction of a railroad from Rogerson, Idaho, to Wells, Nevada. This road will be about 85 miles in length, connecting with the Oregon Short Line at Rogerson and the Southern Pacific and Western Pacific at Wells. The road will afford direct rail haul from the Salmon River mining region to the smelters near Salt Lake City, reducing the distance between mines and smelter at least one half. Heretofore all shipments have been made by truck, 40 miles to the railroad and thence by a long haul to the smelters. One company is said to have ready for shipment a quarter of a million tons of ore now lying on the dump. The ores are chiefly valuable for their silver and copper, the deposits so far as developed to date resembling those of Butte, Montana, it is said.

EXCELSIOR IRON COMPANY GIVES OPTION ON DEPOSITS OF IRON ORE IN UTAH

Growing interest among Eastern capitalists and steel men in the rich iron-ore deposits of Utah is indicated by the announcement that J. R. Walker, through the Excelsior Iron Co., has given Eastern interests an option on his iron-ore holdings in Iron county, the option setting a purchase price on the land at $4,000,000.

Mr. Walker declines to comment on the matter further than to verify the authenticity of the report. The Walker holdings are understood to constitute one of the larger individual pieces of land in the iron fields. It is understood that

other negotiations respecting other similar holdings are under way, and that the chances are that but a short time will elapse before definite development will be started. The activity of railroad surveyors in the southern part of the State is linked in some circles with the interest in the iron-ore development.

D. C. JACKLING GIVES VIEWS ON THE PERIOD OF STAGNATION IN COPPER MINING

D. C. Jackling spent several days in Salt Lake City recently, en route from Yellowstone Park, where he enjoyed a brief vacation. When asked his opinion as to the future of copper mining, Mr. Jackling stated that the international situation has an important bearing; that adjustment of conditions in foreign countries to such a degree as to restore the demand for the use of copper abroad is the key to the situation, or at least one important factor; and that the demand for copper will follow the demand for other raw materials. As to how soon the copper properties under his direction would resume operations, Mr. Jackling stated that early resumption cannot be looked for with any degree of optimism; the situation may be summed up as being neither a question of weeks nor years, but a question of months. As to how many months no one can say. He stated that no plans have been made for a resumption at any of the properties as yet, although the Utah Copper undoubtedly will be among the first of his group to resume operations.

ALASKA

Hyder.—Both the concentrating and cyaniding departments of the new mill at the Premier mine are said to be giving complete satisfaction. It is expected that the first lot of concentrate will be shipped during the first week in August, and that the value of it will be close to $100,000.

ARIZONA

Bisbee.—Members of the 'congress', elected recently by employees of the Copper Queen branch of the Phelps Dodge company, held their first meeting on August 3. A communication from Walter Douglas, president of the Phelps Dodge Corporation, was read to the congress by G. H. Dowell, general manager of the Copper Queen branch. Following this Dowell addressed the congress, explaining the work facing the employees under the new scheme; he urged all to cooperate in an effort to bring about a 'square deal' for everyone concerned. Concluding his remarks, Mr. Dowell said:

"The company stands ready and anxious to do everything within its power to make this representation plan a success. We propose to do our whole duty toward our employees in so far as is humanly possible. If the members of this congress enter upon their duties in the same spirit, and if every employee on the payroll will honestly endeavor to do his duty toward the company as the company intends to do its duty toward him, then this representation plan will prove a tremendous success, and the 'square deal' we all so much desire will be indeed a reality."

Following the general meeting of the congress yesterday, the house of representatives held a meeting at which Sam Verran was elected speaker and Robert McCartney, secretary. The senate will meet for organization in two weeks.

Douglas.—Important reductions in rates on smelter products from points in Arizona and from Cananea, Mexico, to Baltimore and New England points by way of New Orleans or Galveston, in connection with the Southern Pacific Atlantic Steamship Lines have been published to take effect September 12. The rate to New England points has been reduced from $21.10 to $17.60 per ton and to Baltimore the rate is reduced from $20 to $16.50 per ton. These reductions apply only on shipments forwarded by way of the Sunset-Gulf route.

Miami.—Within the past few weeks the Miami Copper Co. has made a shift in its productive operations from its ten-year old No. 4 shaft to a newer opening, known as No. 5. The change was effected without interfering with production. About three years ago the Miami management started a new shaft to relieve the older opening. None of the equipment of the older shaft will be removed, leaving it available should occasion arise. July production was back to around 4,200,000 lb., against but 3,900,000 lb. in June.

Miami has been able to dispose of practically all of the copper it has produced and today is one of the few, if not the only company, now operating at a profit. The bulk of its sales has been for export in which business the company comes into direct competition with the Copper Export Association, of which it was at one time a member.

Tombstone.—Prospects that have not been worked for 20 years are being re-opened in this district. The Bunker Hill company has started one of its compressors for the benefit of lessees in the vicinity.

George Kitt and associates, of Tucson, who have a lease on the State of Maine property from the Bunker Hill company, have just completed a two-mile pipe-line to connect with the main line of the Huachuca Water company, to furnish water for their cyanide plant and for the hoist. They have already started working the cyanide plant on a large stock of ore that was on one of the dumps. Kitt was here last week to inspect the work that is being done and was well satisfied with the showing already made.——H. C. Harsha, of Bisbee, who has a lease on the Cummings property adjoining the Ivey-Critchley lease, has uncovered a good sized body of ore containing lead and silver.——Roger Saunders and the Giacoma Brothers are at work on a claim leased from the Bunker Hill company, near the Oregon, and have already opened some small bodies of silver-manganese ore that promise to lead into larger bodies.

CALIFORNIA

Alleghany.—New equipment is being installed at the Rainbow mine now controlled by a group of mining men from Grass Valley. The mine was formerly a rich producer, but the vein was lost and work was discontinued. Exploration is now directed to the other side of the 'horse' that intercepted the lode.——The Sixteen-to-One company is installing a 20-drill compressor preliminary to extensive underground exploration.

Auburn.—F. Moss has a force of men engaged at the Blue Eyes mine, situated six miles east of Last Chance. A 1200-ft. adit is being extended through lava beds in search of rich channels.——A compressor has been installed at the Glen mine, situated near Miller's Defeat. The company is exploring a narrow channel in which 'pay-dirt' is now being mined at two points 2000 ft. apart.

Caliente.—Carl W. Chilson and J. O. Percival operating the Royal Flush mine have opened a quartz vein at a depth of 90 ft., assays from which average $32.22 in gold. The full width of the fissure has not yet been determined.

Jackson.—Production from the Argonaut mine is increasing. Rich ore is coming from the deep workings, particularly from the 4900-ft. level. Damage resulting from the fire and flood has been repaired.

Placerville.—The Golden Unit company has completed the construction of a mill at the old Argonaut mine, near Greenwood.——It is reported that the districts surrounding Kelsey, Diamond Springs, and Eldorado, all tributary to Placerville, are being actively prospected. Several sales of small properties have been consummated recently.

Redding.—The three important copper companies in Shasta county asked for a reduction in the assessment of their mines, aggregating $1,089,304. The Board of Equalization granted reductions totaling $457,500. The Mountain

Copper Co. asked that the assessment on the Iron Mountain mine be reduced to $50,000. The equalizers fixed the valuation at $350,000. The United States Smelting, Refining & Mining Co.'s Mammoth group of mines was reduced from $449,060 to $275,000; its Sutro mine from $58,000 to $40,000; and its Keystone mine was allowed to remain at $32,000. The company's improvements were reduced $88,920. The Balaklala Copper Co. asked that the assessment on the Balaklala mine be reduced from $262,160 to $43,875. The equalizers thought $175,000 was fair.

Shoshone.—The Paddy Pride, through Patrick Miles, superintendent, has bought from the Goldfield Consolidated 500 ft. of air-pipe and 1000 ore-sacks. The air-pipe will be placed in the 420-ft. lower tunnel, from which a 65-ft. raise is in a 7-ft. width of lead-silver ore assaying 0.04 oz. gold, 61.06 oz. silver, and 73.20% lead. The full width of this ore has not yet been determined. Shipments will be started when the air-pipe is in place, according to Miles.

Sierra City.—Energy is being bent toward the development of a 'pay-shoot' following the discovery of a new vein in the Sierra Butte mine. The vein was found on the footwall side of the old orebody; cross-cuts are being driven in search of possible quartz.

Sonora.—A supply of good ore in sufficient quantity to keep a mill in continuous operation for several years is reported at the Patterson mine. The management has taken steps to equip the property with a thoroughly modern mining and milling plant. The foundation for a 20-stamp mill is under way. A new office building is also in course of erection. The installation of a 150-hp. hoist is planned, as it is desired to have a hoisting equipment that will make possible the sinking of the shaft to the depth of 2000 ft. The development of the Patterson by the present operating company has been under the direction of J. L. Whitney.

COLORADO

Aspen.—The Richmond Hill M. & M. Co. is planning resumption of work on the Little Annie mine following tests on ore made by J. T. Terry, flotation metallurgist of Leadville. The mill will be re-equipped and placed in charge of Terry.——Aspen business men have formed a leasing company to operate the Eclipse group on Castle creek and have forwarded supplies. Veins containing zinc, lead, copper, silver, and gold are exposed in shaft and tunnel workings.

Blackhawk.—A 52-hp. hoist has been installed at the Cyclops tunnel-level by the Midwest M. & M. Co. and two shifts are breaking ore for delivery at the company's Iron City mill, a plant of 75 tons capacity. A third shift is to be employed within 30 days. Flotation concentrate from the 'Brown' process is reported to average 0.64 oz. gold, 105 oz. silver, and 11.65% lead.

Cripple Creek.—The Vindicator Consolidated company is extending a lateral north-west from the 19th level of the Golden Cycle shaft, corresponding to what will be the 20th level of the Vindicator No. 2. The objective is the present terminal point of the Roosevelt deep-drainage tunnel, some 3000 ft. distant. Negotiations looking to extension of the tunnel are under way, but no agreement has as yet been reached. The Vindicator is now raising water from the Golden Cycle, but with the tunnel-connection completed this heavy cost will be eliminated. Development of the rich shoot on the Lillie vein at the 2000-ft. depth on the Vindicator continues from the Cycle cross-cut, and, with the raise through to the Vindicator shaft, sinking will be started in ore as the rich vein extends to the shaft station. The extension of the tunnel rests with other companies owning property in the Bull Hill area, who are expected to contribute to the general cost, estimated at $30,000. The Vindicator company, however, will extend the deep lateral to its end-line at its own expense. The Vindicator at the present time is draining the Bull Hill area, and it feels that property owners should contribute toward the tunnel extension through other than Vindicator holdings.

A Recent Photograph of the A. S. & R. Co.'s Smelter at Murray, Utah, Showing the New Stack

Montezuma.—Ore assaying between 400 and 700 oz. silver per ton has been opened in a tunnel on the Berry group at a depth of 1250 ft. Five tons, rich in ruby silver, will be forwarded to the Arkansas Valley smelter at Leadville for treatment.

Salida.—The Parks-Davis Chemical Co. of New York has purchased the Ohio and Colorado smelter in this city for a consideration reported at $400,000. A cash payment of $150,000 was made in Denver when the deal was closed on August 1. The Parks-Davis company controls the Raleigh mine in the Salida district and its ore containing arsenic, lead, zinc, and products used in the manufacture of drugs will be treated at the smelter.

IDAHO

Coeur d'Alene.—W. A. Williams, of Spokane, recently cut in his prospect in the Pine Creek district a stringer of ore

as wide as his hand that assayed $47 in silver and lead. He made the discovery in an open-cut only 14 ft. below the surface.——Payment for the first carload of ore shipped from the Sidney mine showed a net value of about $30 per ton, which means that a 50-ton car has a net value of $1500. The ore that is being shipped is practically all taken out in the course of extending the two drifts.——A bond has been taken for a reported consideration of $80,000 on the Terrible Edith mine, two miles above Murray, by H. A. Morse, a mining engineer of San Francisco. It is a lead and zinc property that was extensively worked for a good many years previous to the War. Shipments of more than $100,000 worth of ore have been made in past years and the property has 3000 ft. of underground work. A lower tunnel will be driven.

Fairfield.—Six-horse teams are hauling mill machinery to the Walton mine. G. R. Collins, general manager, says he has bought a sawmill to cut mine-timbers and timber for ore-chutes; he believes the company will be producing concentrate within 60 days. Spokane men are interested.

MISSOURI

Joplin.—Persistent rumors that prominent Eastern capitalists have combined to buy into the Tri-State field of Missouri, Kansas, and Oklahoma during the present slump in prices continue to emanate from mining headquarters in Joplin; the activities of agents of these interests lend strength to the belief that this is true. It has been understood here that one of the largest companies recently gave an option on all its holdings, including four concentrating plants, and it is believed here that the option will be closed. A few of the richer mines continue steady operations, and production from them is quite as large as any time in the past. One of the significant developments at present is the sinking of the new shaft by the Chanute Spelter Co. on the land west of the Hartley tract. The shaft is going down more than a quarter mile from the Hartley mill, but it is understood it is the plan of the Chanute company to handle the 'dirt' from the new shaft in this mill, using a long surface tram. This is interpreted as marking the tendency of the times to avoid building new milling units. A cheering feature is the news that slab zinc has been sold for export; this seems to prove that prices have reached a level where no more zinc will be imported.

MONTANA

Butte.—The Anaconda company, in a drift on the 2800-ft. level of the Gagnon mine, has opened a deposit of ore that is rich in copper glance. Whether or not the ore is in one of the silver veins of the Alice group is not known. If this is the lower extension of one of the silver-zinc veins the development is of the utmost importance.——The new discovery of the Anaconda company will also serve to direct the attention of the Davis-Daly company to its Mt. Moriah and New Era claims that are situated in the same part of the district. The Davis-Daly company expects to reach the 750-ft. level, with its Hibernia shaft, within 60 days. A crosscut 700 ft. long will then be driven to explore the vein.—— The Butte & Superior company is rapidly approaching the point at which the copper-bearing vein already found on the 2050-ft. level should be entered on the 2200-ft. level. The shaft has now reached the 2600-ft. level.

NEVADA

Argentite.—The shaft at what is known as the Sanger-Taylor property at Argentite, formerly known as Cow Camp, has been sunk to a depth of 100 ft. and a drift is being driven at this depth. The ore, 4 ft. wide, is of "very good grade," according to Taylor. Sixteen men are employed in building a six-mile road to the claims, and when this has been completed machinery will be moved to the shaft. All work to date has been done with a windlass. The claims were optioned recently by a company controlled by the Wattersons of Inyo county, California.

Ely.—The Ely Northern Copper Co. has opened a deposit of copper ore 43 ft. wide that assays 5.42% copper. The property on which it is operating is owned by the Boston & Ely Consolidated Mining Co.——S. Herbert Williams has secured a bond and lease on the property of the Ely Revenue Copper Company.

Goldfield.—The Goldfield Development Co. at Gold Hill is drifting east from the bottom of the new 200-ft. shaft; the farthest west of the ore-shoots of the tunnels should be cut in about two weeks. There are two tunnels, driven by former owners, the upper 500 ft. long and the lower, which reaches a depth in the vein of 270 ft., 700 ft. long. Both are drift tunnels. Three ore-shoots are said to be exposed in them, one 140 ft. long, another 160 ft. long, and the third has been opened for 20 ft. in the lower tunnel. The ore contains copper, silver, and gold, with the first increasing as depth is gained. The vein is 14 to 70 ft. wide.

Donald and Giles, Florence lessees, recently made their second shipment, 60 tons of $140 ore. They have been doing development work, but are nearly ready to resume stoping. The next shipment is expected to be several tons of rich ore they have sacked.

Mina.—The Simon Silver-Lead Mines Co. has acquired control of the Kirk-Simon Smelting Co., at Harbor City, California. The plant is being re-modeled to treat the zinc flotation concentrate from the new mill here. Zinc oxide will be the product of the Kirk-Simon plant. The situation near tidewater will be advantageous in marketing the product.

Peavine.—The Standard Metals Co. is employing two shifts at its mine and mill. Two grades of concentrate are being produced; one containing silver and lead; the other, gold, silver, and copper. Production is at the rate of 90 tons of concentrate per month. The shaft will be sunk to the 500 point, as indications on the present bottom level (300-ft.) are excellent.——According to C. H. Dennison, manager for the Wedekind Silver Mining Co., the drift on the 100-ft. level has been advanced 127 ft., disclosing a vein from 3 to 6 ft. wide.——At the Black Panther drifting in both directions is being done on the 300-ft. level.

UTAH

Alta.—David Phillips, manager for the Alta Tiger Mining Co., reports that at a distance of 65 ft. up a raise which is following No. 1 fissure, along the contact of the black and gray lime, five feet of ore was cut. Assays show $3 in gold, 20.8 oz. in silver, and 8.1% lead.

Eureka.—Exceptionally good progress is being made in the sinking of the Water Lily shaft at the Chief Consolidated mine by Walter Fitch, Jr., mine contractor. During the first ten days, the three-compartment shaft was sunk a distance of 135.5 ft. Progress is now being made at the rate of about 16 ft. per twenty-four hours, using three shifts. Unless exceptionally bad ground or a heavy flow of water is met, Mr. Fitch expects to establish a new record for shaft sinking. The shaft will be sunk to a depth of at least 1000 ft. as a preliminary step toward the development of the extensive holdings of the Chief Consolidated in the eastern part of the Tintic district.

The work of re-timbering and enlarging the shaft at the Eureka Standard property, adjoining the Tintic Standard, is progressing. E. J. Raddatz, president of the company, is desirous of starting development soon. The property is well equipped and is situated in a promising part of the district.

Lewis Merriman has been elected president of the Tintic-Zenith and Tintic-Union mining companies. It is believed that this is a preliminary step toward the amalgamation of these two companies with the Apex-Standard Mining Co., which is controlled by Mr. Merriman. The holdings of the Tintic-Zenith and Tintic-Union companies embrace more

than 60 claims. Recently additional claims have been patented by Merriman and associates, and if the expected deal goes through, the new company will have one of the largest groups of claims in this district. The Apex Standard has been developing steadily, and while ore in large quantities has not been found, high-grade bunches have been cut from time to time.

Ore shipments for the week ending July 30 totaled 153 cars, as against 156 cars for the preceding period. The Tintic Standard shipped 56 cars; Chief Consolidated, 31; Iron King, 14; Dragon, 10; Victoria, 10; Iron Blossom, 6; Centennial-Eureka, 3; Little May, 2; Swansea, 2; Colorado, 2; Gemini, Bullion-Beck, Eureka Hill, Mammoth, Gold Chain, Sunbeam, 1 each.

Park City.—Shipments of ore from this district for the week ending July 30 totaled 1397 tons, of which the Silver King Coalition shipped 534; the Judge allied companies, 474; and the Ontario, 389. During the previous week, shipments totaled 1273 tons.

Salt Lake City.—Effective August 11, the freight-rate on lead bullion from Utah smelting points to the Atlantic seaboard was reduced from $22 to $16.50 per ton. During 1920, the mines of Utah produced 1,343,200 tons of ore, exclusive of the production from the Utah Copper mine at Bingham. Most of this was silver-lead ore, and it is estimated that the reduction in freight on bullion will result in a saving to mine operators of approximately 60c. per ton, or a total saving of more than $800,000 per annum. Inasmuch as the smelting companies increased their charges when the freight-rate on bullion was advanced, it is believed they will now give the mine operators the benefit of the reduction.

The coal-mining companies of the State report a pronounced betterment in the situation as applying to their products. An average of from 250 to 350 cars of coal per day is being shipped by the mines in Carbon county, most of which is billed to Pacific Coast points. The Denver & Rio Grande road has lately put on 15 additional locomotives to handle the increased traffic between the coal mines and this city.

WASHINGTON

Valley.—Edwin Seaman and his son were plowing last spring when their attention was attracted by a rock, turned up by the plowshare, that looked like ore. Selected samples have shown returns of 29.6% copper, with some gold and silver. The rock that Mr. Seaman considered a nuisance in his field is now said to be the outcropping of a vein that can be traced across his farm. Work done in open-cuts has produced ore of good grade. A shipment of sorted material is to be sent to the smelter.

Kettle Falls.—Assays of ore taken from a vein near Shannon creek, 12 miles west of here, where 30 claims have been located, show $95 to $250 in gold and silver on selected specimens, according to reports. Several tons of $45 ore are said to have been broken.

BRITISH COLUMBIA

Hope.—Work has been resumed on the Emancipation mine, 15 miles from here. W. Fleet Robertson, Provincial Mineralogist, made an examination of this property last year, and in his report stated that the showing justified the bond that the Liberator Mining Co. has entered into with the Emancipation company. The Liberator, the present operators, hope to demonstrate the existence of a large body of milling ore. Most of the gold taken from the property in the past came from small rich off-shoots from the main vein.

New Denver.—It is understood that R. R. Hedley, who recently secured a lease and bond on the Arlington, will ship a trial lot of ore from the old dumps to the Ottawa mill to be treated; should the experiment be found to be profitable a large quantity of this material is available.——The Wakefield mine, at Four-mile creek, is being re-opened. Old-timers in the camp have great confidence in this mine, and believe it will 'come back', as the Silversmith and Queen Bess have done.

Prince Rupert.—W. R. Tonkin, of Seattle, has 20 men employed at development work on his property, at Fish creek. The ore is said to be rich in gold and silver on the surface; the object of the development is to prove the ore at depth.——A compressor is being added to the equipment at the Homestake mine, at Kitsault glacier, Alice Arm district. This property has been opened extensively by open-cuts and a considerable orebody has been exposed, which is said to average about 60 oz. in silver and 6% in copper. The great drawback to the property is its inaccessibility.——It is reported that the syndicate that has been exploiting the oil-shale on Graham island, one of the Queen Charlotte group, intends to erect a commercial plant to extract the oil from the shale. The company has had a small experimental plant running for some time.——Finds of good ore are reported from the Hobo claim, in the Salmon River, and the Patricia group, in the Marmot River districts.

Trail.—The ore receipts at the smelter for the week ended July 21 totaled 8405 tons, the Consolidated company's mines supplying 7977 tons. The other shippers were: Anna, Slocan, 20 tons; Whitewater, Slocan, 36; Gold Hill, Taghum, 42; Knob Hill, Republic, 47; and Surprise, Republic, 283.

Victoria.—Word has been received from John Dresser to the effect that he is on his way to Hudson's Hope to take control of the drilling operations that are being undertaken by the Provincial government to further explore the oil possibilities of the Peace River district. Dresser said he would make an examination of the well that is being bored by the Imperial Oil Co., at Pouce Coupé, on his way to Hudson's Hope. He reports that the Government well, which is being drilled by Lynch Brothers, of Seattle, is down 800 ft. and that the favorable formation should be reached at a depth of 1700 feet.

MEXICO

Durango.—Kenneth A. G. Shearer, prominent English mining man of Guanacevi, is going to develop the Tamesis mines in the Hacho arroyo near the Aurora and Marslatur mines.——Reinaldo Avila, operating in the Inde district, has filed on the vacant ground contiguous to the gold and silver mines Tres Varones, El Repecho, and Constancia.——Jesus Gonzales has filed on a group of 14 pertenencias in the San Diego district south of the Refugio mines.——Alejandro Rodriguez, representing Juan A. Gallardo, has located several new claims in the Huizar mountains near the city of Durango. Some good specimens of gold and silver ore have been taken from shallow workings.

Mexico City.—The production of metals in Mexico during the twelve months ended in June is given as follows in kilos (one kilo equals 2¼ lb.): Gold, 10,420; silver, 922,212; copper, 46,056,900; lead, 121,434,066; zinc, 14,363,075; mercury, 77,229; antimony, 1,572,376; graphite, 2,911,529; tungsten, 34,917; tin, 1588; arsenic, 1,198,806; and manganese, 838,624.

Mexico has abolished the export duty on silver, the law having already gone into effect.

Zacatecas.—The mining agency at Concepcion del Oro has registered three new filings this week. One of them is for a group of six silver-copper claims in the San Pedro de Ocampo district, to be titled under the name of Le Reina de San Pedro. The property is situated near the Naranjera and San Francisco de los Muertos mines. Another location is made by Jose R. Zamora in the Mazapil copper district,

consisting of two promising claims. The third, to be called the San Antonio del Ojo del Agua, is located by I. G. Puente, associated with several other mining men. The group is composed of nine claims which lie contiguous to the old Zacatecas, Flor de Maria, Morelos, and other patented claims in the Sierpe district. J. R. Dyer and associates have re-located the old Anexas de Zaragoza mines in Los Muertos mountains under the name of Tenochitlan.

ONTARIO

Kirkland Lake.—The Wright-Hargreaves is now operating on a larger scale than any other mine in the district, the mill treating about 150 tons daily. Stopes have been opened up in several parts of the mine but the mill is kept going mainly on development ore. Small steel balls are to be substituted for pebbles in the tube-mills, as the ore is found to be harder than the pebbles.

A circular issued in London by the Kirkland Lake Proprietary (1919) states that work on the Tough-Oakes and Burnside properties has shown developments of a most satisfactory character particularly by the location of a payable vein west of the main north and south fault on the Tough-Oakes. Details are given of a scheme for the reorganization of the Canadian Sylvanite Company. It has been arranged for the Kirkland Lake Proprietary to subscribe jointly with an American group of financiers for the 80,000 unissued shares of $5 each of the Sylvanite and reorganize that company with a total capital of $3,000,000 in one dollar shares, of which $2,000,000 will be issued to the shareholders in the present Sylvanite Co. in the ratio of five shares for one. The remaining 1,000,000 shares are to be held in reserve giving the Kirkland Lake Proprietary and the American group the option of acquiring 500,000 shares each over a period of two years.

The Teck-Hughes proposes to increase its milling capacity from about 100 to 160 tons per day and his given orders for a ball-mill, tube-mill, and classifier, with accompanying equipment.——At the Wood-Kirkland eight veins have been discovered by surface work within 200 ft. of the shaft.

The Lake Shore has been enabled to resume dividend payments and has declared dividends of 2% payable August 10 and 2% payable November 10.

The Ontario-Kirkland is making a new permanent shaft near the mill-site by raising from the 400-ft. level to connect with a shaft started from the surface.

At the Queen Lebel a good vein 8 ft. wide has been cut; assays yield satisfactory results.

Larder Lake.—The Crown Reserve of Cobalt is exploring its claims near the Canadian Associated Goldfields and has uncovered a vein 40 ft. wide, 20 ft. of which carries fair gold content.

Matachewan.—Work in this field is being held up by reason of transportation difficulties and lack of power.——At the Thesaurus mine mining equipment has been installed and operations are being carried on by steam-power.

Porcupine.—Following a meeting of the directors of the McIntyre it was officially announced that work would be started at once on an addition to the mill of 500 tons capacity, bringing the total daily capacity up to 1000 tons. It was also given out that the station on the 1625-ft. level is completed; the sinking of the shaft will now be resumed. The recent find now being developed on the 1375-ft. and 1500-ft. levels is stated to be "a body of high-grade milling ore lying to the south of No. 7 vein on the contact between the quartz-porphyry and the basalt".——The Allied Porcupine Mines is unwatering the workings of the Three Nations, which it recently took over together with other properties.

South Lorrain.—The electric motor which drives the 20-stamp mill of the Keeley mine was recently burned out, necessitating the temporary closing down of the plant.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

David Cole is at Cananea.

Leon A. Perret is at Yokohama.

J. M. Callow was here last Tuesday.

Alvin B. Carpenter is at Mexico City.

S. R. Guggenheim is at Island Park, Idaho.

Howard D. Smith has returned to New York.

S. Herbert Williams was at Denver last week.

Richard Roelofs, of Colorado Springs, is at the Fairmont hotel.

J. Nelson Nevius has returned to Pasadena from Silverhorn, Nevada.

H. G. Young has returned to Montreal, Quebec, from Michipicoten, Ontario.

Walter Fitch Jr., mining contractor of Eureka, Utah, is in southern California.

H. C. Carlisle, engineer for the Tonopah Mining Co., is here from Philadelphia.

L. D. Ricketts is making a tour of inspection and was at Globe, Arizona, last week.

V. N. Franchie, on his return from Panama, has gone from San Francisco to Great Falls.

G. M. Ponton, of Montreal, was in San Francisco on his way to Ensenada, Lower California.

H. Foster Bain, Director of the U. S. Bureau of Mines, is expected in San Francisco next month.

Britton B. Gottsberger has been elected secretary of the Mining and Metallurgical Society of America.

Robert H. Hawley, superintendent of the leaching plant of the Utah Copper Co. at Magna, Utah, has resigned.

Stephen Birch, president of the Kennecott Copper Corporation, was at the Nevada Consolidated Copper Co.'s properties recently.

Gaichi Yamada, assistant Professor of Metallurgy at the Kyoto Imperial University, Kyoto, Japan, has been visiting mining districts in Utah.

Luis Ibanez Velasco has resigned as assayer for the Compañia de Petroleo 'El Aguila', at Tampico, Mexico, and has gone to Berlin, Germany.

L. O. Kellogg, superintendent for the South American Development Co., at Portovello, in Ecuador, is spending a holiday at Carmel, California.

H. S. Mullikan, special technical assistant, U. S. Bureau of Mines, will visit the Mines stations at Los Angeles and Berkeley, about the middle of August.

Alejandro Lacasa, metallurgist and mining engineer of Spain, who has been three months in the United States investigating various metallurgical processes, was in San Francisco last week.

OBITUARY

Lawrence Greene, managing director of the Clayton Mining & Smelting Co. of Idaho, died at his home in Salt Lake City on July 30, after an illness of four years. He was born at Ottawa, Canada, on January 25, 1865. In 1885 he went to Clayton, Custer county, Idaho, and began working for the Clayton Mining & Smelting Co. He was with the company for more than 20 years, working up to the position of general manager. He then resigned, and moved to Salt Lake City, where he engaged in other business, but was still retained by the company as managing director. He is survived by his wife and four children, one of whom, Godfrey C. Greene, is a metallurgist for the Nevada Consolidated Copper Company.

THE METAL MARKET

METAL PRICES

San Francisco, August 9

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$72
Platinum, 10% iridium, per ounce	$90
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

August 8.—Copper is inactive but steady. Lead is quiet but firm. Zinc is dull and unchanged.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 2	61.25	38.87	June 27	58.69	35.25
" 3	61.00	38.62	July 4	58.90	35.33
" 4	61.12	38.62	" 11	58.69	36.75
" 5	61.75	38.75	" 18	60.25	37.56
" 6	61.75	38.75	" 25	60.14	37.85
" 7 Sunday			Aug. 1	61.66	39.05
" 8	61.87	38.12	" 8	61.46	38.62

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Aug. 2	11.75	June 27	12.68
" 3	11.75	July 4	12.62
" 4	11.75	" 11	12.62
" 5	11.75	" 18	12.62
" 6	11.75	" 25	12.43
" 7 Sunday		Aug. 1	12.04
" 8	11.75	" 8	11.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 2	4.40	June 27	4.32
" 3	4.40	July 4	4.43
" 4	4.40	" 11	4.43
" 5	4.40	" 18	4.40
" 6	4.40	" 25	4.40
" 7 Sunday		Aug. 1	4.40
" 8	4.40	" 8	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Aug. 2	4.70	June 27	4.88
" 3	4.70	July 4	4.75
" 4	4.70	" 11	4.77
" 5	4.70	" 18	4.76
" 6	4.70	" 25	4.72
" 7 Sunday		Aug. 1	4.75
" 8	4.70	" 8	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.09	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
July	12	48.00	
"	19	47.50	
July	26	47.50	
Aug.	2	47.50	
"	9	47.50	

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

GOLD IMPORTS AND THE RESERVE SYSTEM

The Federal Reserve Bank says in commenting on the volume of gold imports the past few months and their relation to the Federal Reserve system:

"When Congress passed the Federal Reserve Act one of its major purposes was to provide elasticity of currency and credit. Gold was to form the sole reserve behind Federal Reserve notes, the new elastic currency, and was to be the principal reserve behind reserve bank deposits, which increase as bank loans and deposits expand. Congress did not specify in dollars or percentages what these reserves should amount to, except as to minimum requirements, and even these were not absolutely rigid.

"In practice the reserve ratios of the system pass through a wide range, but thus far have never fallen to the minimum below which they cannot go without payment of penalty. These minimum percentages are 40% of gold behind notes and 35% of gold and lawful money behind deposits. In the middle of July 1920 gold behind all Federal Reserve notes in circulation, after allowing for required reserve against deposits, amounted to 40%, and in July 1921 to 80%. The corresponding ratio of New York Reserve Bank rose from 46% to more than 100%.

"It is from holdings of reserve banks that gold is mainly withdrawn at times when it is flowing away from the country, and it is into reserve banks that gold mainly goes when the flow is toward the United States. Consequently, if the outflow coincides with a heavy credit demand, as between July 1919 and July 1920, reserve ratios rapidly decline; if the inflow coincides with a lessened credit demand as at present, reserve ratios rise rapidly. In either case, flexibility of the Federal Reserve system permits adjustment to demands for credit from industry, commerce, and agriculture, and former adverse consequences of heavy gold movements, such as a sharp curtailment of credit when gold flows out, are minimized.

"Sunply of gold in the United States is now at its highest point, though not much higher than before restrictions on export of gold were removed in June 1919. During the last 12 months, because of conditions without precedent in any like degree, there has been a great flow of gold from Europe. The total stock in the United States on July 1 was $3,223,000,000, estimated about 40% of the world's stock.

"The gold recently received came largely from private sources, and served mainly to reduce foreign indebtedness to this country. Gold holdings of most of the European central banks are larger than before the War. The Bank of England has more than three times as much gold as in 1913, the Bank of France more than half as much again, and even the German Reichsbank has nearly as much gold as before the War. That does not mean necessarily that the entire stocks of gold in those countries are greater than before the War, because the tendency has been for the gold to be assembled in central banks, where it should serve as the basis for credit and issues of currency."

MONEY AND EXCHANGE

Foreign quotations on August 9 are as follows:

Sterling, dollars:	Cable	3.66⅝
	Demand	3.66
Francs, cents:	Cable	7.86
	Demand	7.84
Lire, cents:	Demand	4.42
Marks, cents		1.24

Eastern Metal Market

New York, August 3.

Inactivity is general in all the markets. Price changes are more pronounced in copper while in the other metals prices are almost stationary.

Speculative copper, and metal in weak hands, has weakened the market without stimulating buying.

On most days the tin market has been inactive but prices have been firm.

Lead is more freely offered, but quotations are steady.

There is still little life to the zinc market.

Antimony is a little lower.

IRON AND STEEL

The latest transactions in steel products have shown substantially the same low prices as were revealed in the previous week, with here and there a new decline; sheets and plates apparently are the lines of least resistance, says 'The Iron Age'. Willingness to name a price that will take the business, where the tonnage is larger than usual, is still the attitude of the leading steel companies, albeit sentiment is better in view of a somewhat larger volume of orders and inquiries and the feeling that improvement in other industries will soon be felt in iron and steel. Some publicity has been given to what is called a new and lower schedule of prices by the Steel Corporation, particularly on bars, plates, shapes, tin-plate and sheets, but the figures given have been the basis of ordinary transactions for more than a fortnight.

The general average of steel-mill operations in the Pittsburgh, Youngstown, and Wheeling districts is somewhat higher this week, due largely to the starting of departments that have been idle, in some cases, for several weeks.

The returns of July pig-iron production confirm the week-to-week reports last month that iron and steel works operations were declining. In the 31 days of July, 864,555 tons of pig-iron was made. This was at the rate of 27,889 tons per day, or more than 20% less than the June rate of 35,494 tons per day, the June total being 1,064,833 tons. Not since December 1903, nearly 18 years ago, when 846,695 tons was produced, has the country seen so small a pig-iron output as last month's. July showed a net loss of 7 active furnaces, 69 being in blast August 1, with a capacity of 28,175 tons per day, against 76 on July 1, representing a daily capacity of 32,195 tons.

COPPER

There is practically no improvement with the turn of the month. Some claim that the weak and speculative copper has disappeared, but others deny this and freely admit that the electrolytic copper market is down to 12c., delivered, which means 11.75c., New York. Demand is light and is easily satisfied with the cheaper offerings. Not all sellers, particularly the large producers, will sell as low as 12c., and some refuse to quote under 12.50c. The unsettlement in exchange has put a damper also on foreign buying, which just now is light. It is interesting, however, to note that Germany is now our heaviest buyer, having ranked first in the last five months previous to June when she took more than twice as much as any other country. For the 11 months ended with May, this year, Germany had taken 27% of the total exports which compares with 33% before the War, or in 1913, when she was preparing for war.

TIN

There is not much activity. On most days the market has been featureless and buying absent. On one day the middle of last week about 200 to 250 tons was sold, mostly future shipment from the Straits, which was sold both to consumers and dealers. The market on yesterday and Monday was quiet and nominal at 26.75c. and 26.50c., New York, respectively, for spot Straits, largely because the London market was closed on Monday, due to bank holidays. Previous to that buying in London was fairly heavy. Quotations there yesterday were only 5s. per ton higher than a week ago with spot standard at £158 10s., future standard at £160 10s., and spot Straits at £159 per ton. Statistics for July show deliveries into consumption to have been 1521 tons, with stocks on July 31 at 1721 tons, and in landing at 800 tons. Imports for the first 7 months have been 10,418 tons as compared with 31,613 tons to August 1, 1920.

LEAD

The situation is little changed. Independent producers are offering a little more freely at 4.40c., New York, or 4.20c., St. Louis, but the demand is not equal to the supply at these levels, which represent the market. The leading interest continues its quotations of 4.40c., New York and St. Louis, for wholesale lots for early delivery.

ZINC

There is improvement reported in the market. Some prime Western in wholesale lots for August delivery is obtainable at 4.20c., St. Louis, or 4.70c., New York, but most producers in this market are apathetic and asking 4.25c., St. Louis, or 4.75c., New York, for the little business presented.

ANTIMONY

Antimony is stagnant but prices are only a little lower at 4.60c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The leading producer has not changed its quotation for virgin metal, 98 to 99% pure, which stands at 24.50c. f.o.b. plant, for wholesale lots for early delivery. Importers are asking as low as 21c. per pound, New York, duty paid, for the same grade of foreign aluminum.

ORES

Tungsten: There is no business. Quotations are nominal at $3 per unit and upward, depending on the grade of ore and other conditions.

Ferro-tungsten is obtainable as low as 55c. per pound of contained tungsten, but there is no demand.

Interest centres on the proposed tariff and it is figured out that the new bill imposes a duty of about $9 per unit on ores and 72c. per pound on the tungsten contained in alloys.

Molybdenum: Quotations are nominal in a quiet market at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: The market is devoid of business and asking prices are unchanged at 22c. per unit, seaboard, for high-grade ore.

Manganese-Iron Alloys: There are inquiries for about 700 to 800 tons of ferro-manganese and about 350 tons has been sold. Quotations are about $70, delivered, for the domestic alloy and $70, seaboard, for the British. One representative of a British producer has a limited tonnage which he is holding at $70, delivered. Spiegeleisen is quoted at $26, furnace, with sales of carload lots reported.

Ferro-silicon, 50%, is now obtainable as low as $60, delivered, and there are inquiries for a few carloads.

Exports of Mexican oil from Tampico during the third week of July totaled 1,000,000 bbl., of which 650,000 was crude. This is about 20% of the normal rate.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1921	Total	*Latest dividends— Date	Per share
Ahmeek, Michigan	copper	200,000	$25.00	.....	$12,150,000	Sept. 30, 1920	$0 50
Alaska Treadwell, Alaska	gold	200,000	25.00	.....	15,785,000	May 29, 1916	0.50
Allouez, Michigan	copper	100,000	25.00	.....	2,850,000	Mch. 31, 1919	1 00
American S. & R., U. S. and Mex.	c.l.g.s.s.	609,980 (com.) 500,000 (pfd.)	100.00 100.00	609,980 1,750,000	46,465,578 74,046,386	Mch. 15, 1921	1 00
Am. Z. L. & S., Missouri and Tenn.	c.l.z.s.g.	193,120 (com.) 96,560 (pfd.)	25.00 25.00	....	....	June 1, 1921	1.75
Anaconda, Montana	c.z.s.g.	2,331,250	50.00	.....	5,903,300	May 1, 1920	1.50
Argonaut, California	gold	200,000	5.00	.....	174,773,125	Nov. 1920	1.00
Atolia, California	tungsten	100,000	1.00	.....	1,980,000	Mch. 20, 1920	0 05
Arizona, Arizona	copper	1,519,896 £316,530	5s. 7% pfd.	....	5,264,500 2,713,728	Dec. 14, 1918	0 50
Arizona Commercial, Arizona	c.g.s	265,000	5.00	.....	24,637,894	Aug. 31, 1919	0.18
Barnes-King, Montana	gold	400,000	5.00	.....	1,086,500	May 31, 1920	9d.
Bingham Mines, Utah	l.s.g.	150,000	10.00	.....	440,000	Oct. 31, 1918	0.50
Bunker Hill & Sullivan, Idaho	l.s.	327,000	10.00	490,500	25,683,750	July 31, 1920	0.05
Butte & Superior, Montana	z.s.l.	290,184	10.00	.....	16,940,257	Sept. 30, 1919	0.25
Butte Copper & Zinc, Montana	z.s.l.mn.	600,000	5.00	.....	300,000	July 1, 1921	0.25
Caledonia, Idaho	l.s.	2,605,000	1.00	20,840	4,282,256	Sept. 1917	1.25
Callahan Zinc-Lead Co., Idaho	z.l.s	325,000	10.00	.....	7,721,688	July 1918	0.50
Calumet & Arizona, Arizona	copper	642,521	10.00	642,521	46,272,992	Jan. 5, 1921	0.01
Calumet & Hecla, Michigan	copper	100,000	25.00	.....	152,250,000	Dec. 30, 1920	0.50
Cardiff, Utah	l.s.	500,000	1.00	.....	875,000	June 27, 1921	0.50
Centennial, Michigan	copper	90,000	25.00	.....	360,000	June 30, 1920	5.00
Cerro Gordo, California	l.z.s.	1,000,000	1.00	.....	300,000	Dec. 20, 1920	0.15
Champion, Michigan	copper	100,000	25.00	.....	25,850,261	Dec. 31, 1918	1.00
Chief Con., Utah	l.z.s.g.c.	884,232	1.00	132,605	2,004,122	Jan. 15, 1918	0 05
Chino, New Mexico	copper	869,980	5.00	.....	29,991,709	Apr. 15, 1920	6.00
Columbus-Rexall, Utah	c.s.g.	586,234	1.00	.....	14,656	Aug. 1, 1921	0.05
Con. Arizona Smelting, Arizona	c.g.s.	1,663,000	5.00	.....	498,900	Sept. 29, 1920	0.37½
Copper Range, Michigan	copper	395,000	25.00	.....	26,998,345	Dec. 30, 1918	0.02½
Cresson, Colorado	gold	1,220,000	1.00	.....	8,857,162	Dec. 17, 1918	0.10
Daly, Utah	l.s.g.	150,000	20.00	.....	3,142,500	Sept. 15, 1920	0.50
Daly West, Utah	s.l.	250,000	20.00	.....	6,868,000	June 10, 1920	0.10
Davis-Daly, Montana	copper	600,000	10.00	.....	900,000	July 1, 1920	0.10
Dragon Con., Utah	c.l.s.g	1,875,000	1.00	.....	206,250	Dec. 1, 1920	0.25
Ducktown, Tennessee	copper	198,000	4.80	.....	2,678,702	Mch. 30, 1920	0.25
Eagle & Blue Bell, Utah	l.c.z.s.	893,146	1.00	44,657	1,607,663	April 25, 1920	0.01
East Butte, Montana	copper	421,849	10.00	.....	1,676,370	May 1917	0.96
Electric Point, Washington	lead	793,750	1.00	.....	444,500	Apr. 28, 1921	0.05
Elkton Con., Colorado	gold	616,884	1.00	.....	3,579,460	Dec. 31, 1919	0.50
Empire, Idaho	copper	1,000,000	1.00	.....	300,000	Oct. 1, 1920	0.12
Engels, California	copper	1,791,926	1.00	.....	698,684	May 1915	0.02
Federal M. & S., Idaho	l.z.s.	pfd. 120,000	100.00	240,000	15,451,653	June 30, 1918	0.04¾
First National Copper Co., Cal.	copper	600,000	5.00	.....	660,000	Oct. 19, 1918	0.01½
Gemini, Utah	g.s.c.	5,000	100.00	.....	2,490,000	June 1920	1.00
General Development, U. S.	.....	120,000	25.00	.....	5,033,917	Feb. 25, 1919	0.15
Golden Cycle, Colorado	gold	1,500,000	1.00	60,000	9,573,300	Aug. 1920	6.00
Goldfield Con. Mines, Nevada	gold	3,559,148	10.00	.....	29,177,789	Aug. 20, 1920	0.50
Grand Central, Utah	l.s.	600,000	1.00	.....	1,825,450	June 10, 1921	0.02
Hecla, Idaho	l.s.	1,000,000	0.25	230,000	8,735,000	Dec. 31, 1919	0.05
Homestake, South Dakota	gold	251,160	100.00	188,370	42,115,929	June 20, 1920	0.03
Inspiration, Arizona	copper	1,181,967	20.00	.....	38,983,704	June 28, 1921	0.08
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	.....	3,275,000	July 1, 1921	0.25
Iron Cap, Arizona	copper	142,100	10.00	.....	1,031,892	Oct. 1920	1.00
Iron Silver, Colorado	silver	500,000	10.00	.....	5,350,000	April 26, 1920	0.02½
Isle Royale, Michigan	copper	150,000	25.00	.....	2,025,000	Sept. 20, 1920	0.25
Jim Butler, Nevada	s.g.	1,718,021	1.00	.....	1,151,074	Jan. 1, 1919	0.10
Judge M. & S., Utah	l.z.c.s.g.	480,000	1.00	.....	2,550,000	Aug. 30, 1919	0.50
Kennecott, Alaska	copper	2,786,679	5.00	.....	53,502,344	Aug. 1, 1918	0.07
Liberty Bell, Colorado	gold	133,560	5.00	.....	2,701,026	Oct. 1, 1920	0.12½
Lucky Tiger, Sonora, Mexico	g.s.	715,337	10.00	336,208	7,805,781	Dec. 20, 1920	0.50
Magma, Arizona	copper	240,000	5.00	.....	1,704,000	June 30, 1920	0.10
Mass Con., Michigan	copper	100,000	25.00	.....	486,585	July 20, 1921	0.13
Miami Copper Co., Arizona	copper	747,114	5.00	747,114	23,704,171	Jan. 6, 1919	0.50
Mohawk, Michigan	copper	100,000	25.00	.....	9,675,000	Aug. 15, 1917	1.00
Nevada Con., Nevada	copper	1,999,457	5.00	.....	46,768,626	May 16, 1921	0.50
Nevada Packard, Nevada	silver	1,164,492	1.00	.....	110,627	Nov. 1, 1920	1.00
Nevada Wonder, Nevada	s.g.	1,500,000	1.00	.....	1,549,005	Sept. 30, 1920	0.25
New Cornelia, Arizona	copper	1,800,000	5.00	.....	1,350,000	April 20, 1919	0.02
New Idria, California	quicksilver	100,000	5.00	.....	2,705,000	May 21, 1919	0.05
New Jersey Zinc, New Jersey	zinc	350,000	100.00	1,680,000	12,880,000	Aug. 25, 1920	0.25
North Butte, Montana	c.s.g.	430,000	15.00	.....	14,657,000	Jan. 1, 1919	0.25
North Star, California	gold	250,000	10.00	.....	5,100,000	May 10, 1921	2.00
Old Dominion, Arizona	c.s.g.	297,071	25.00	.....	14,405,260	Oct. 28, 1918	0.25
Ontario Silver, Utah	s.l.	150,000	100.00	.....	14,157,500	Dec. 31, 1920	0.30
Oroville Dredging, California	g.	686,538	£1	.....	£429,036	Dec. 31, 1918	1.00
Osceola, Michigan	copper	96,150	25.00	.....	14,849,475	Jan. 4, 1919	0.50
Phelps Dodge, Ariz., N. Mex., Mex.	c.s.g.	450,000	100.00	1,575,000	97,646,527	Sept. 1920	9d.
Plymouth Con., California	g.	240,000	£1	.....	£156,000	June 30, 1920	0.50
Portland, Colorado	gold	3,000,000	1.00	.....	11,692,080	July 1, 1921	1.00
Quincy, Michigan	copper	110,000	25.00	.....	27,002,500	Mch. 1920	12d.
Ray Con., Arizona	copper	1,577,179	10.00	.....	25,412,621	Oct. 20, 1920	0.01½
Rochester Silver Corp., Nevada	silver	3,750,000	1.00	88,536	88,536	Mch. 29, 1920	1.00
Shannon, Arizona	copper	300,000	10.00	.....	1,425,000	Dec. 31, 1920	0.25
Shattuck, Arizona	c.l.s.g.	350,000	10.00	.....	7,612,500	Nov. 15, 1917	0.25
Silver King Coalition, Utah	l.s.	1,250,000	5.00	182,415	15,380,975	Jan. 20, 1920	0.25
Silver King Con., Utah	l.s.c.g.	850,537	1.00	.....	1,562,705	May 1, 1921	0.15
St. Joseph Lead, Missouri	lead	1,409,466	10.00	774,679	22,529,690	April 1, 1918	0.10
						June 20, 1921	0.25

*These figures include dividends payable on or before July 1, 1921.

Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	Latest dividends: Date	Per share
Success, Idaho	l.s.	1,500,000	1.00	.....	795,000	July 1916	0.03
Tamarack & Custer, Idaho	l.s.	1,776,500	1.00	71,060	586,185	Jan. 1921	0.04
Tennessee Copper, Tennessee	copper and acid	391,498	no par value	.....	5,606,250	May 15, 1918	2.00
Tintic Standard, Utah	l.s.	1,174,500	1.00	117,470	1,538,332	June 30, 1921	0.05
Tom Reed, Arizona	gold	909,555	1.00	.....	2,919,671	Dec. 20, 1920	0.03
Tonopah-Belmont Dev., Nevada	s.g.	1,500,000	1.00	150,000	10,343,063	April 1, 1921	0.05
Tonopah Extension, Nevada	s.g.	1,282,801	1.00	129,271	2,684,526	April 1, 1921	0.05
Tonopah Mining, Nevada	s.g.	1,000,000	1.00	50,000	14,975,000	April 20, 1921	0.05
United Eastern, Arizona	gold	1,363,000	1.00	408,900	3,543,800	April 28, 1921	0.15
U. S. S. R. & M., U. S., Mexico	l.z.c.s.g.	com. 351,115 / pfd. 486,350	50.00 / 50.00	175,557	15,315,779 24,881,268	Jan. 1921 / Oct. 15, 1920	0.50 / 0.87½
United Verde Copper, Arizona	copper	300,000	no par value	900,000	55,997,900	June 10, 1921	1.50
United Verde Extension, Arizona	copper	1,050,000	0.50	787,500	11,937,500	May 1921	0.25
Utah Apex, Utah	c.l.s.g.	528,200	5.00	.....	1,254,475	Nov. 11, 1920	0.25
Utah Con., Utah	c.l.s.g.	300,000	5.00	.....	12,810,000	Mch. 25, 1919	0.25
Utah Copper, Utah	copper	1,624,490	10.00	2,436,725	113,946,387	June 30, 1921	0.50
Utah Metal, Utah	l.c.g.s.	691,588	1.00	.....	895,734	Dec. 10, 1917	0.30
Vindicator Con., Colorado	gold	1,500,000	1.00	.....	3,847,500	Jan. 24, 1920	0.01
Wellington Mines, Colorado	l.z.	1,000,000	1.00	.....	2,050,000	Jan. 2, 1919	0.10
West End, Nevada	s.g.	1,788,486	5.00	.....	1,251,940	June 5, 1920	0.10
Wolverine, Michigan	copper	60,000	25.00	.....	10,350,000	Jan. 2, 1920	0.50
Yellow Pine, Nevada	z l.	1,000,000	1.00	.....	2,593,000	Sept. 30, 1920	0.03
Yukon Gold, Alaska, Cal., Nev.	gold	3,500,000	5.00	.....	9,858,110	June 1918	0.02½
CANADA							
Belmont Surf Inlet, British Columbia	g.c.	2,500,000	1.00	.....	500,000	Jan. 1, 1920	0.02½
Coniagas, Ontario	silver	800,000	5.00	100,000	10,840,000	May 1921	0.12½
Con. M. & S., British Columbia	l.c.z.s.g.	419,098	25.00	.....	7,099,596	Oct. 1, 1920	0.62½
Crown Reserve, British Columbia	silver	2,000,000	1.00	.....	8,300,000	Dec. 30, 1916	0.05
Dome Mines, Ontario	gold	4,000,000	10.00	1,000,000	2,919,167	April 1, 1921	0.25
Florence, British Columbia	l.s.z.	1,100,000	1.00	.....	35,300	April 20, 1919	0.01½
Granby Con. M. S. & P., B. C.	c.g.s.	150,000	100.00	.....	10,662,837	May 1, 1919	1.25
Hedley, British Columbia	gold	240,000	10.00	.....	2,495,520	June 30, 1919	0.10
Hollinger, Ontario	gold	4,920,000	5.00	1,476,000	14,836,000	July 15, 1921	0.05
Howe Sound, B. C. and Mexico	copper	1,984,150	1.00	99,207	1,190,490	Jan. 15, 1921	0.05
International Nickel, Ontario	n.c.	com. 1,673,384 / pfd. 89,126	25.00 / 100.00	.....	53,113,676 / 8,288,604	Mch. 1, 1919 / May 1921	1.00 / 1.50
Kerr Lake, Ontario	silver	600,000	4.00	150,000	9,015,000	April 1921	0.12½
Lake Shore, Ontario	gold	2,000,000	1.00	40,000	320,000	Jan. 20, 1921	0.02
La Rose Mines, Ontario	silver	1,500,000	1.00	.....	6,300,546	April 15, 1918	0.20
McKinley-Darragh, Ontario	silver	2,247,692	1.00	.....	5,955,392	Dec. 31, 1920	0.03
McIntyre, Ontario	gold	3,640,283	1.00	182,014	2,366,184	May 22, 1921	0.05
Mining Corp., Ontario	silver	1,660,050	5.00	.....	5,499,868†	Sept. 15, 1920	0.12½
Nipissing, Ontario	silver	1,200,000	5.00	780,000	22,920,000	April 30, 1921	0.15
Porcupine Crown, Ontario	silver	2,000,000	1.00	.....	840,000	June 1, 1917	0.06
Rambler-Cariboo, British Columbia	l.z.s.	1,750,000	1.00	.....	560,000	Feb. 15, 1919	0.01
Standard, British Columbia	l.z.s.	2,000,000	1.00	.....	2,700,000	Oct. 15, 1917	0.05
Temiskaming, Ontario	silver	2,500,000	1.00	.....	2,159,156	Jan. 31, 1920	0.04
Tough-Oakes, Ontario	gold	531,500	5.00	.....	398,625	Jan. 15, 1917	0.12½
Trethewey, Ontario	silver	1,000,000	1.00	.....	1,211,999	Jan. 2, 1919	0.05

*In addition there was a payment of $600,000 made on July 3, 1919, to the Kerr Lake Mines, Ltd., as a return of capital to the stockholders of that company.

†In addition $1,652,260 was paid by individual companies prior to the amalgamation in 1914.

Book Review

Concentration by Flotation. Compiled and edited by T. A. Rickard. John Wiley & Sons, Inc., New York. 692 pp., ill. For sale by 'Mining and Scientific Press'. Price, $7.

The material in this book is a compilation of articles that have appeared in the 'Mining and Scientific Press' during recent years. Five of these, constituting 'The Flotation Process', were published in book form in 1916; 17, comprising 'Flotation', appeared in 1917. The new book contains, in addition to the 22 articles already published in book form, 18 later contributions to the subject, thus bringing the study of flotation up to date, and providing, in convenient form, a compendium of the best literature that has been published on the technology of the process.

The book offers evidence, if such were needed, of the large amount of material on flotation, technical and technolegal, that Mr. Rickard has contributed to current literature. In the present treatise he is responsible for the original production of about 25% of the contents; the range of subject matter is extensive; the versatility of the editor of the 'Mining and Scientific Press' will be apparent to every reader. A glossary of scientific and technical terms serves as an introduction; this will help the engineer or the layman to understand the fundamentals of this most important development in metallurgy. Mr. Rickard's contributions to the book include chapters on the history and the principles of flotation, the flotation of gold and silver mineral, flotation practice of the Utah Copper Co., the smelting of flotation concentrate at Garfield, together with a critical and masterly, though condensed, exposition of flotation litigation, freed, as far as is possible, from legal jargon. Other chapters deal with the theory of flotation by a number of writers and investigators, including O. C. Ralston, Glenn L. Allen, E. E. Free, C. Terry Durell, H. Hardy Smith, Robert J. Anderson, Joel H. Hildebrand, Will H. Coghill, H. P. Corless, and C. L. Perkins. A chapter by James M. Hyde discusses the testing of ores; another is contributed by O. C. Ralston and Glenn L. Allen. E. J. Atckison describes the flotation of semi-oxidized silver ore. The cyanide treatment of flotation concentrate is dealt with by Charles Butters and J. E. Clennell; and the recovery of copper from flotation concentrate by leaching is discussed by Percy R. Middleton. Current practice at well-known mills is described by James Hebbard, R. T. Mishler, Hallet R. Robbins, W. E. Simpson, Edwin T. Henderson, R. J. Harvey, A. H. Heller, and C. C. Freeman. W. Shellshear contributes a chapter on preferential flotation; and H. Hardy Smith, one on the cascade method. The book concludes with a résumé of literature on the theory of flotation, with critical notes, by H. R. Adam. Both the editor and the publisher are to be congratulated on the appearance of an attractive volume, which will serve as a reliable text-book to all who are in any way interested in the flotation process.—A. W. A.

Spiegeleisen, as made in Europe, may contain from 10 to 35% of manganese, states an Imperial Mineral Resources bulletin. British and American standard spiegeleisen contains about 20% of manganese.

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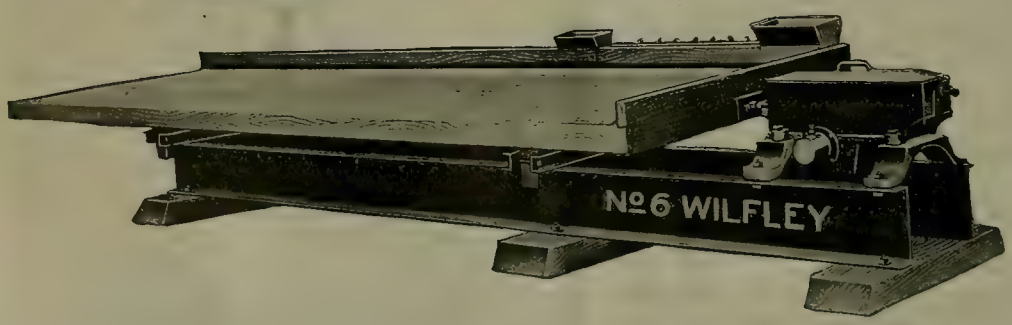


T. A. RICKARD, - - - - Editor

GOLD mining is generally considered to be a vicarious occupation for engineers, but the St. John Del Rey Mining Company can boast an average length of service of the heads of departments now at Morro Velho of 23 years. Is this a record?

WALTER LYMAN BROWN, who is representing the American Relief Association in Russia, is one of the mining engineers to whom the War gave an opportunity for large public service. He used to be stationed at Rotterdam as distributing agent for the Commission for Relief in Belgium, and in our issue of September 21, 1918, he wrote an article describing the good work done by himself and his associates under Mr. Hoover.

IN spite of the destruction by enemy action of over 13 million gross tons of sea-going vessels between August 1, 1914, and November 11, 1918, and the loss through marine hazards of an additional 2,390,000 tons during the same period, the world's mercantile tonnage afloat is today greater than it would have been had the average rate of increase for the ten years prior to 1914 continued since that date, according to the 'Commerce Monthly'. Estimates of tonnage now afloat indicate a total in excess of 60 million gross. Afloat—yes! But too many of the ships are merely affording a safe anchorage for barnacles. The new director of the U. S. Shipping Board asks for a subsidy of $300,000,000 for the coming fiscal year. The sum mentioned is as good a guess as can be made at the present time, he says; a bigger sum may be needed. All in favor of unlimited taxation, say 'aye'.

NEGOTIATIONS, initiated by a committee of the American Mining Congress, for the purpose of arranging a settlement of the flotation litigation have come to an abortive conclusion, for the present at least. It appears that the Minerals Separation people asked $15,000,000 for their patent rights, whereas the representatives of the copper companies, their principal opponents, offered $5,000,000. Some slight concessions were made, we understand, but in the end the Minerals Separation people refused to take less than $11,000,000, and the other side declined to raise their offer to any such figure. This is a pity, for we believe that it is greatly to the interest of all concerned, and of the mining industry, that litigation should be settled out of court. If Mr. Lloyd George and Mr. De Valera can meet and reconcile their differences, we do not despair of Mr. John Ballot and Mr. D. C. Jackling being able to do so likewise if both could be caught in a conciliatory mood.

SUCCESSFUL mining engineers realize that their professional work involves no circumscribed routine; it embraces a little or much of almost every branch of human endeavor; there is hardly a phase of industrial, social, or scientific advance that is not viewed with at least some degree of interest. The failure of the mediocrity is due generally to mental insularity, and to a lack of appreciation of what has been done in other industries, as well as in his own particular 'line'; the success of the professional man often follows an acquisitiveness for information on any or every subject, and a cultivated ability to discard the useless, to discern at sight the valuable or the interesting, and to classify the information so that it is readily available. We are not directly concerned with the distillation of oil from shale, but we realize that the subject is interesting and important; therefore in this issue we reproduce an article by Mr. David E. Day, of the Day Company of this city, because the problems discussed are somewhat similar to many that occur in some phases of metallurgy, and because of the author's lucid presentation of principles, facts, and conclusions—a circumstance that points to careful investigation, and gives the promise of technical success.

STATISTICIANS have estimated that, without the use of modern machinery, several billion slaves would be needed to keep the wheels of industry turning at their accustomed rates; but it is obvious that, although machines may displace manual labor, manual labor could not do the work that many machines are doing today, however many billion of workers were put to the task. In this issue we publish several pertinent comments by Sir Robert Kotzé, Government Mining Engineer in the Transvaal, on the relations between fatigue and the atmospheric conditions in mines. His conclusions are shared by many, for he reminds us that improved economy of exploitation and better health will result if we are economical of the muscular labor of those who work underground and amid conditions that are not always healthful. Substitute as far as possible, he says,

the energy of the machine for the muscle of the laborer. This advice has been anticipated to a great extent during the last decade in countries where labor of all kinds is costly, but its logic has yet to be realized in many places where labor is considered cheap. We would, however, emphasize the point that the so-called cheap labor is usually most expensive in the end. It is not generally realized that against the cheapness of the native labor on the Witwatersrand must be debited the heavy levies that are met by the companies for the maintenance of the various phthisis sanatoriums, for payments of compensation, and on account of the money that the industry loses in training and teaching men who afterward develop a debilitating or fatal disease. Apart from the economic aspect of the matter, it must be admitted that, so long as it remains a factor to be considered, the white plague is a reflection on the social side of the mining industry. So long as miners' phthisis occurs as a result of honest labor, so long will it be impossible, as it is with war, to count the expenditure in terms of dollars and cents. If atmospheric conditions underground are bad, then let them be remedied by mechanical ventilation; if ideal conditions are impracticable of attainment, then let it be realized that muscular labor should be reduced to a minimum, and machine methods utilized to the full.

Wages and Costs

The chronic economic disagreement between capital and labor, between employer and employee, is not likely to be settled until both are prepared to deal justly by one another. In our mining districts at this time there are many strikes and rumors of strikes in consequence of the effort to lower the rate of wages in accordance with the decline in the cost of living. Obviously, as wages were increased in consequence of an advance in the cost of living, it is just that they should be decreased when the economic tide recedes. Among the efforts made sincerely to adjust the matters equitably is the arbitration now in progress at Grass Valley, California. This gold-mining centre is one of the most attractive and prosperous of the communities that came into existence in the early days—seventy years ago. By reason of the persistent productivity of its mines, especially the Empire and North Star, the people of Grass Valley have escaped many of the disagreeable vicissitudes incident to gold mining; owing to its pleasant climate and agreeable position, on the western slope of the Sierra Nevada, it has become a place of homes; it is a community of English-speaking people, including many Cornish; it has not, like many other industrial centres, been invaded by immigrant aliens. The principal mines have long been under the same management, and it is a management of educated and experienced engineers, not lacking the humane feelings to be expected of a properly educated man. Therefore the relations between the managers and the men have been on a friendly and self-respecting footing. Here, if anywhere, one might expect that the wrangle between the two sides in the economic struggle could be adjusted reasonably; and that here at least the problem of deflation would be settled fairly and peaceably. This is what is happening. On July 1, 1920, wages in the district were raised to $5 per day for miners and $4.75 for shovelers, an agreement to that effect for one year being made between the mine operators and the Mine Workers Protective League, which is the name of the local union. To this organization the mine operators, as represented by the managers of the mines, have raised no opposition; every employee is a member of it, even the shift-bosses, assayers, and master-mechanics. The mines are run on the 'open shop' system, but no man is prejudiced by being a member of the union or by not being a member. The men are not discouraged from joining the union nor intimidated if they do. Last year the union undertook to force a man—he happened to come from Australia—to join them; he refused to do so, but said that he would have joined if they had "come to him decently about it"; when coercion was attempted, he balked. We know of no locality where the 'open shop' is more fairly observed; in many other places it is a sham. At each mine there is a grievance committee; and the management "likes it", I am told, because the committee often makes excellent suggestions and the men usually choose good men to represent them.

So far, so good. It will be agreed that the conditions do credit to all concerned. The North Star began operating at one-third capacity on May 1, 1920. By July of that year the principal companies were employing a full force, but it was soon found that the men were not working efficiently; they loafed; they had been spoiled by the war-time spirit, which was expressed by grabbing at high wages without giving a fair return in labor, a spirit that was reduced to an absurdity in the naval dockyards and munition factories, while the pseudo-workers were being coddled as heroes of the home line of defence. How pitiful all that insincerity seems now! One man at Grass Valley, for example, bragged that he could "get by" on two cars per shift, whereas the usual task for a shoveler underground is six or seven cars per shift. It includes some sorting. In consequence of this state of affairs the mines could not be operated profitably. They began to lose money. At one mine it was found necessary to cut down the force to one-third and supply ore to a third of the mill only. By selecting ore of a little better grade, the manager was able to earn a profit. He found that a third of the crew broke enough ore to supply half the mill. Even at the higher wages the efficiency of the select men was such that the ore could be exploited more cheaply than before.

After several conferences between the operators and a wage committee from the League, in an attempt to agree upon a wage-scale to replace the one to expire on June 30, it became apparent that no agreement could be reached. Therefore on June 10, 1921, a letter was sent to the League, or union, stating that the best offer the companies felt justified in making was a reduction in the wages of miners to $4.25. At the same time it was announced that shovelers would receive 50 cents less, in-

stead of 25 cents less than a miner's wages because it had been discovered that many men preferred to be 'muckers' at 25 cents less, rather than do the drilling. The League refused to accept the offer. The North Star began to discharge its force preparatory to stopping all work. On July 1 all the men not already discharged failed to come to work except the pump men and hoist engineers, who remained at the old rate of wages. The League called them out, but did not call a strike, because that could not be done without a secret vote and the leaders had good reason to believe that such a step would not be endorsed by the rank and file, who, it is believed, were willing to come back on the new terms. Moreover, as the companies were still paying the old scale of wages, there was no excuse for a strike. So the pump men were "requested to quit". They did; but two of the companies brought men from the outside, so their pumps were not stopped. The Empire prepared to stop pumping. Within a few days the League suggested arbitration, and this the companies accepted forthwith on the mutual understanding that a settlement should be made on the basis of the cost of living, that is, the wages as of July 1, 1920, were to be reduced in proportion to the decrease in the local cost of living since that date, with the proviso that there should be a difference of 50 cents between the wages of miners and muckers in any event. On July 15 the men went back to work at the scale of wages proposed by the operators, leaving the final settlement to their leaders. Those representing the miners believed that there had been less decrease in the cost of living at Grass Valley than elsewhere. Each side was to appoint an arbitrator and the two were to select a third. Unfortunately the chief spokesman for the miners caused himself to be selected. He is Mr. William Southcott, who for twenty years has worked as hoist-engineer at the North Star mine; he is Mayor of the town, and a power in the Methodist church. The companies selected Mr. Allen P. Matthew, a lawyer of San Francisco and connected with the firm that is retained by one of the companies. The company side was represented in the negotiations by Messrs. George W. Starr of the Empire, Arthur B. Foote of the North Star, and John A. Fulton of the Idaho-Maryland mine. A difficulty has arisen in the selection of the third arbitrator—*the* arbitrator, in effect—because Mr. Southcott has nominated a gentleman who is in politics, and politics, of course, is the death of economic fairness, because, in this case, for example, the men represent many votes and the managers only a few. To us it seems obvious that the third arbitrator should be one entirely detached, somebody not living in the district and in no way connected with any of the disputants. A professor of economics from one of the two principal Californian universities would seem to us a person suitable for the purpose. Here we advert to the objection suggested in the selection of Mr. Southcott. A partisan, especially one committed already to a fixed point of view, is unlikely to be a fair arbitrator. The companies did not select one of the mine managers, nor should the leaders of the union have forced their chief on the board of arbitration. Meanwhile we note that the mine managers after a detailed examination of the statistical evidence available, satisfied themselves that the decline in the cost of living since July of last year has been 28%, whereas the other side argued that it was not more than 12%. A decline of 15% would justify, statistically, the reduction of wages to the schedule suggested by the operators. It is difficult, of course, to establish an average cost of living, because the household budget varies in different homes; moreover, the prices at which things are being retailed today are by no means uniform even for standard articles, because some merchants are trying to sell old stocks bought at war prices for as little less as possible, whereas others can sell cheaply the cheaper stocks purchased by them since the unpleasant process of deflation began to go into effect. However, where there is a will there is a way, and we feel confident that three fair-minded intelligent men can decide justly. If it can be done anywhere, it can be done at Grass Valley, provided always that exuberant egoisms are kept in subjection. We await the result with keen interest, for a satisfactory conclusion should serve as an example for other mining districts.

Discussion

This department is lively again this week. We are glad to hear from our friend Mr. Edgar Hall, who quotes an incident of prospecting in Australia to suggest how silver may be melted out of an ore, as in the story of Potosi. Both Mr. Allen H. Rogers and Mr. W. Spencer Hutchinson write on the licensing of engineers, and we are pleased that our mention of the matter has elicited their opinions on so important a subject. However, as Mr. Rogers affirms, we gave the findings of the American Association of Engineers for what they were worth; we offered, and we offer, no argument for or against licensing in general; we admitted that the problem "is beset with difficulties". In discussing the work of corporations and unrestricted partnerships we had in mind those cases in which the opinions of professional engineers, with a specialized knowledge and experience of a particular branch of technology, and no commercial interest in the venture, have been over-ridden to make room for the pseudo-technical reports of such unrestricted corporations as we attacked, the partners of which are vitally interested in the profits to be made, not out of the technical or economic results of their recommendations, but out of the initial cost of the plant or the initial expense of erection. American industry has suffered by such aggressive action against the privileges of practising engineers; technical failures have resulted, thus throwing discredit on skilled technicians as well as upon that branch of the industry in which they are interested. The professional engineer, whose advice might well have been considered in the first instance, must often remain idle until, in desperation, he accepts a salary for work in the field. We would, of course, demur from any suggestion that a firm such as the General Electric Company should

be prevented from issuing plans for the erection of its own machinery. But Mr. Rogers must realize that professional advice is often given gratuitously by a commercial firm that is interested in the erection or sale of plant equipment and in connection with a problem of which none of its staff has any special knowledge. If the State control of engineers is to be considered, it is obvious that such encroachments on the activities of practising professionals ought to be checked. The Mining & Metallurgical Society of America, we understand, is considering the question of licensing in all its aspects; we again suggest that its researches should include a study of the matter to which we have drawn attention. The revision of the mining law is the subject of three letters. The first is by Mr. John F. Davis, who speaks as a lawyer conversant with the troubles arising from the effort to reconcile the facts of nature with the acts of legislation. However, it is fair to say that the square location is not the idea of a "theoretical engineer"; we do not know who first brought it forward, but as adopted in the proposed revision it is fathered by a number of mining engineers of wide experience and high reputation. We are glad that Judge Davis quoted the paragraph from his own previous statement on the subject, because it holds good today and is an excellent summary of the matter told in convincing language. Mr. Emile M. Renaud also does not like the revision, and he gives his reasons for not liking it, the first of which is the difficulty of adopting cardinal lines when locating a claim. To this, prospectors generally seem to object. Mr. Renaud clings to the right of location by discovery, because the omission of this requisite plays into the hands of mere speculators, who can plaster the ground adjacent to a discovery with claims on which no prospecting has been done, and so cause the discoverer to lose part of his reward. On the other hand, Mr. Frank L. Sizer comes to the rescue of the revisers, although he also objects to an annual tax of $5 per acre in lieu of the $100 worth of assessment work. A plea for the tariff on quicksilver is made by Mr. A. E. Kellogg. Mr. Algernon Del Mar returns to the discussion of the question of chloridizing roasting, and insists that zinc chloride is not a solvent for silver chloride. We would like to hear from a few more mining engineers on the subject of the proposed revision of the mining law; it is a matter of great importance and is well worthy of thorough discussion before it is decided by Congress.

Industrial Co-operation

A plan to promote better relations between the Phelps Dodge Corporation and its employees at the Copper Queen branch, and to provide means for the prompt and equitable settlement of complaints and grievances, has received the approval of over 80% of the men, and has gone into effect. In many respects the proposals are novel, the plan having been modeled on the Constitution of the United States, under which, as the general manager, Mr. C. H. Dowell, states, "every individual is given an opportunity for advancement according to his ability and determination, and every citizen is given a voice in making the laws that govern him". The plan was first submitted, by the Employees Conference Committee and the Foremen and Bosses Committee, to the company officials for approval. The Board of Directors and the general manager sanctioned the plan, provided it could be shown that, as determined by secret ballot, the majority of the employees were in favor of it. The result of a vote, as already mentioned, was overwhelmingly in the affirmative.

The plan provides for the establishment of a House of Representatives and a Senate, as well as executive and judicial departments. All employees will have a voice in the adoption of rules and regulations that govern their work and the conditions of their employment. The employees will vote by ballot, every six months, to elect representatives from among themselves. No employee who is classified as a foreman or a boss, or whose duties are of a supervisory nature, is allowed to vote for, or to serve as, a representative. The House chooses its own officers, appoints its own committees, adopts its own rules, and punishes its own members; it assembles once a month, and may be convened at other times by the head of the Executive Department. Members of the Senate are chosen from the foremen, the bosses, and those whose duties are of a supervisory nature, but no superintendent or head of a major department is allowed to act; like the House of Representatives, the Senate meets once a month, appoints its own committees, adopts its own rules, and punishes its own members. Provision is made for freedom of speech in both assemblies; no penalizing is permitted. Measures only become effective when they have passed both Houses of Congress, and have been approved and signed by the head of the Executive Department. If a measure does not meet with his approval, he returns it, with his objections, to where it originated, when it may be reconsidered or revised. On the other hand, any measure may become effective over the veto of the head of the Executive Department by a vote of two-thirds of the members of each House. Congress may enact legislation dealing with safety rules, the employment and discharge of employees, the allocation of rewards to employees in return for the introduction of economies or improvements, the provision of pensions, and the establishment of benefit societies. A Standing Committee will hear grievances on the part of the men, and will make decisions. Congress will be empowered to pass measures to provide an educational course in mining methods and management, the graduates from which will be considered, in preference to others, for positions of responsibility; it may establish a plan of apprenticeship, whereby the young men in the community may learn a trade; and it may 'legislate' with the idea of facilitating the peaceful settlement of all differences between the company and its employees. The constitution exhibits a broad-minded tolerance in granting the right to work to anyone, irrespective of race or nationality, or membership or non-membership in any organization, the principles of which are not in conflict with the Constitution and laws of the

United States or of the State of Arizona. The company, however, reserves the right to increase or decrease production, or the scale of its operations in any or all departments, without question, and as it sees fit. The head of the Executive Department is the general manager of the Copper Queen branch; his 'cabinet' will consist of the assistant manager, together with the superintendents of the mine, of the reduction plant, and of the concentrator. All measures passed by Congress will be approved or disapproved within ten days after presentation. The general manager, as head of the Executive Department, may make recommendations to Congress, he may convene either or both Houses in extra session, he may attend

tion of the plan emphasizes the fact that all should be interested in corporate affairs. The experiment will be watched with interest. The plan has been based on a sound and logical foundation, the Constitution of the United States. We wish Mr. Dowell, the general manager for the Phelps Dodge Corporation at the Copper Queen branch, and the chief of the Executive Department, the loyal support of his Congress.

Iron-Ore Resources of Europe

The iron and steel industry is a barometer of national progress. The bulletin by Mr. Max Roesler on

OUTLINE MAP OF EUROPE, SHOWING RESERVE OF IRON IN ORE

The circles have been drawn according to the scale shown in the diagram in the right-hand bottom corner, in which the unit circle represents the world's output of pig-iron in 1913 (about 80,000,000 metric tons). The solid centre represents the known reserve; the shaded part, the probable reserve; and the open circle, the possible reserve. A cross indicates that the reserve is less than 20% of the world's output in 1913.

meetings and participate in discussions. He has the power to grant reprieves and pardons. A Supreme Court of three judges will be appointed by him; it will have original jurisdiction in cases in which the constitutionality of any measure is in question, and appellate jurisdiction in cases arising out of grievances between employees and those in authority over them. The formula-

the iron-ore resources of Europe, recently issued by the U. S. Geological Survey, is the outgrowth of a report that was compiled by the Survey for use at the Peace Conference. As the subject is one of general interest, it is fitting that the report should be arranged for publication in convenient form. Although the Conference re-adjusted the political divisions of Europe, it is obvious

that racial antagonisms, class struggles, and divergent economic demands will cause further changes. Sufficient information is available, however, to show the new political significance of the large deposits of iron ore in Europe. The principal changes of ownership that have occurred as a result of the Great War are summarized as follows: The part of the minette deposits that lies in Lorraine Annexée has been returned to France. Of the German bog ores, the part estimated for Posen has been allotted to Poland, together with the small deposit of Triassic ores in that part of Silesia the ultimate ownership of which remains to be determined by a plebescite. The small deposits near Krakow, in Galicia, also go to Poland. The iron ores of Bohemia and Moravia, as well as those of the Szepes-Gömör district, which lies in the Ruthenian country, on the southern slopes of the Carpathians, have been allotted to Czecho-Slovakia. The deposit in the Vares district, in Bosnia, has been transferred to Jugo-Slavia. The deposits in eastern and south-eastern Hungary (those of Banat and Hunyad being the only extensive ones) are regarded as belonging to a greater Rumania. Poland and Finland, parts of old Russia, are considered as independent. The uncertainty in regard to Poland's eastern frontier and the re-arrangement of the Baltic States does not affect the allocation of the iron-ore reserves of that region, because the unallotted territory contains no ores that are considered as valuable enough to be reported.

The summary shows that, out of a total of 12,405 million metric tons of iron in iron ore, France has the largest reserve, which amounts to 35.2% of the total. Great Britain is second with 18.2%. The Swedish, representing 12.5% of the total, is largely in the form of high-grade ore; the British ores are carbonates and hematite, and are of a much lower grade. The calculation of reserve of ore in Great Britain is complicated by the fact that a considerable proportion of the ore cannot compete with that produced abroad, even if readily available for mining; so that, in spite of the enormous reserve in Great Britain, the use of imported ore is increasing, and the production of domestic ore is declining. Germany comes fourth on the list, with 11.1%; and we are told that she has shown an ability to use her own resources to such an extent that the local pessimists are probably wrong in assuming that her future lies only in agricultural expansion. Spain stands fifth with 5%, but difficulty and expense in transportation, which have been left out of consideration in calculating the reserve, make it questionable whether the whole amount will ever be mined. Central Russia is sixth, with 4.2%; Norway, seventh, with 3.8%; and Southern Russia, eighth, with 2.8%. Belgium, Portugal, Jugo-Slavia, the Caucasus, Finland, Rumania, Italy, Switzerland, and Bulgaria all have small reserves; Turkey in Europe has some ore; Holland, Denmark, and the Baltic States contain almost none. Mr. Roesler's compilation concludes with a comprehensive bibliography of the literature of the subject, together with a number of excellent maps, one of which we reproduce herewith.

Mexican Labor Problems

Subordinates should be led, not driven; in the War it was the officer who knew that his men were behind him who achieved success. The same attitude should be observed by those of us whose work takes us to foreign countries, and where the personal element is an important factor in the conduct of successful industrial operations. Mr. Alonzo Crittenden makes this point clear in his article on the management of Mexican labor, which appears elsewhere in this issue. The correct attitude for the foreigner to observe in such a country is not an easy one, neither is the best course of action always obvious. The so-called Latin-American is unstinted in his courtesy to the foreigner. To many this appears to be insincere and surficial; but the attitude is due to a strict and invariable observance of the customs of the country, to which our southern neighbors hold an unswerving allegiance. The foreigner must realize this. In return he must endeavor to combine an equal measure of amiability, for diplomacy's, if not for sincerity's, sake, in his dealings with the Mexicans of all classes. If he does this he will be repaid amply. His attitude on matters of administration or operation must be sure and certain; his decisions must be fair, logical, and to the point. He must bear in mind that Mexico, like many other countries, is cursed with a drink habit that befuddles the workers on occasion and is the cause of nine-tenths of the unreliability that is such a deterrent to efficient industrial effort. This condition is inevitable; and allowance must be made for the fact that the *peones* have been permitted a full measure of self-determination in this respect. With one type of foreigner only is a knowledge of the language inadvisable: those who consider the Mexican merely as a machine whose mentality has only reached that stage of development of which it may be said that curses and insults constitute the only suitable form of communication. For such, a linguistic handicap is advisable. In this connection we are reminded of a manager of a small property in northern Chihuahua who refused to learn Spanish. One day, when on a visit underground, he found that the Mexican in charge of the pumps had, with misplaced zeal, stupidly tampered with the nuts of a stuffing-box, and with unhappy results. Being unable to vent his wrath in the language of the country, the manager sent for the book-keeper, who was a fluent linguist. "Tell this ——————", he said, shaking his first in the face of the erring Mexican, "that if I ever catch him monkeying with this —— pump again, I'll pull every —— whisker out of his —— face." The book-keeper quietly told the Mexican, in understandable Spanish, that the attitude of the *jefe* should be disregarded, and that it would be better in the future for him to restrain his initiative in the matter of machinery alteration until he was surer of the result. The manager, unable to understand a word of the book-keeper's admonitions, thought that his fiery invective had been translated verbatim; and, subsequently, that the improvement in pump-control underground was due to his threats; but the book-keeper knew otherwise.

The Discovery of Potosi

The Editor:

Sir—In your issue of April 2, commenting on Prof. Gowland's essay, you refer to the discovery of Potosi by the Indian who stumbled over a stump and fell, and so exposed some bright silver, a story we learnt as children.

Some years ago I had an experience which makes that story probable and intelligible. A small prospect, long since abandoned, from which a few shipments of silver ore had been made in the early days, is situated in the bush at a spot favored by picnickers. During the dry year of 1912 the ground was swept by a fierce bush-fire, which destroyed the timber of the shaft, and the workings collapsed. At the next picnic the children came running in great excitement; they had "found silver"!

Where the heavy hardwood logs had burnt slowly in the dump at the shaft there was much charcoal plentifully spangled with silver. Under the conditions there, at the time, if a lump of hornsilver had been lying at the foot of a stump, the bush-fire might easily have produced like conditions to those which led to the discovery of Potosi.

EDGAR HALL.

Silverspur, Queensland, June 2.

The Evasion of Licensing

The Editor:

Sir—It seems to me that your editorial on this subject in your issue of July 16 was written under a misapprehension. You state that the New York licensing law "permits corporations and unrestricted partnerships to practise irrespective of the conditions of this law. They are exempt". As I read the law, this is not correct. Section 39 k is as follows:

"Corporations or partnerships. A corporation or partnership may engage in the practice of professional engineering or land surveying in this state, provided the person or persons connected with such corporation or partnership in charge of the designing or supervision which constitutes such practice is or are licensed as herein required of professional engineers or land surveyors. The same exemptions shall apply to corporations and partnerships as apply to individuals under this act."

This can only be interpreted to mean that corporations or partnerships engaged in the practice of engineering or land-surveying must do the work by means of licensed engineers in their employ. They cannot practise otherwise as your editorial seems to state.

On the other hand, except for this provision, they may continue to practise engineering exactly as they are doing now. So it is hard to see how the effect of this law will have the result described in the sentence where you say: "Conditions are permitted under which a group constituted in whole or in part of men who are not engineers may violate, with impunity, the codes of ethics that have been adopted by various professional societies for the guidance of their members and for the protection of the public".

Your statement regarding the action of the American Association of Engineers at its recent convention at Buffalo is not in accordance with my understanding of the fact. It is my impression that the A. A. E. is the only organization of engineers that favors these pestiferous licensing laws. Their opposition, as declared in a resolution at Buffalo, has been directed against permitting corporations to practise engineering under any conditions. In this, in the case of the New York law, they were seconded by the Society of Consulting Engineers. If, as I understand it, they had been successful in amending the law in accordance with their ideas, such concerns as the General Electric Co. would have been prevented from issuing plans for the installation of the machinery they sell. It is difficult to see how any manufacturing concern could continue its business under such conditions.

I note that at the conclusion of your editorial you have given the Association's argument in full detail, from which I infer that the information on which your edtiorial is based has been obtained from that organization. What object they have in misrepresenting the facts I do not know; in fact, their policy of trying to force the system of licensing on the engineering profession seems to me exactly opposed to their declared purpose to promote the economic and social welfare of its members. In this State they did their utmost during the last session of the legislature to get a licensing bill passed, but in this movement they were successfully opposed by the members of the national societies. That they have been successful in so many States is, I think, much to be deplored, but if we are to have licensing laws, I question whether one much better than that of the New York State could be drawn.

ALLEN H. ROGERS.

Boston, July 21.

The Editor:

Sir—Your editorial on this subject in your issue of July 16 seems to indicate your approval of the legislation providing for the registration and licensing of engineers.

I want to tell you of the opposition to such legislation which has developed in Massachusetts. A bill was proposed at the last session of the legislature. It was sponsored by the American Association of Engineers, and that organization was active and insistent in its efforts to get favorable consideration. The Boston section of the American Institute of Mining and Metallurgical Engineers joined with the other engineering societies here in opposition to the bill before the legislative committee. Our efforts resulted in postponement to the next session of the legislature.

We are opposed to any law requiring registration or licensing of engineers, for the reason that there is no public need or general demand, whereas the laws proposed and already adopted in some of the States endangers our business, and the fees required are an unnecessary and offensive tax.

Boston, July 26. W. SPENCER HUTCHINSON.

Revision of the Mining Law

The Editor:

Sir—I have read the letter of J. R. Johnson, of Silver City, New Mexico, published in your issue of the 6th inst., and I most heartily agree with it, and hope the "departmental miners" at Washington will give heed to its wise practical suggestions.

This agitation for the square location is of perennial recurrence. Generally, it is fathered by some theoretical engineer seated in a swivel-chair, who is utterly without any realization of what would be the legal and practical effect of such legislation at this late day. The increasing familiarity of many of our prominent mining men with the square location of Mexico and its results has had much to do with fostering a sentiment in its favor. This recurrent agitation is no new thing. As early as 1880, B. C. Whitman, of Nevada, and Judge Hallett, of Colorado, openly advocated it, and the Public Land Commission urged it upon Congress, while Chief Justice Beatty, of California, and R. W. Raymond, strenuously contended for the extra-lateral right, at any rate until the era of active prospecting should have actually passed away. See Report of Public Land Commission of 1880.

The unanswerable point made by Mr. Johnson is that the practical effect of this fussy "remedy" will accomplish nothing except to make confusion worse confounded by giving us two systems of location instead of one: preserving the extra-lateral right for all past locations and giving us the square location only for future locations.

The idea founded on the tin-bounding of Cornwall and the original lode-claim system of Prussia has strong anchorage in this country. If, possibly under conditions analogous to those that obtained in Prussia at the time, the extra-lateral right shall ever be abolished, then its abolition now would merit consideration. The extra-lateral right is, however, a vested right at present in all lode patents fulfilling the conditions of the present law, and in all the numberless locations duly made under the lode rules, customs, or regulations. *No amendment can take that vested right away. In all lode mines that at present exist where compliance has been had with the condition of substantial parallelism of end lines, the extra-lateral right is indefeasible, unless the abandonment of the possessory ownership by the owner shall throw the mine itself back into the public domain. Any legislation on the subject, could at most, then, only affect future locations.*

Mr. Johnson is also right in calling attention to the fact that in order to appreciate the merits of the respective systems themselves the point of view of their advocates should not be lost sight of. Twenty years ago, in discussing that phase of the subject in a historical sketch of the mining law of this State, I called attention to this point, and I have seen no reason to change a word which I then said with reference to it. After discussing various phases of the question at that time, I said:

"After all, no matter how honestly the advocates of the two systems contend, the conclusions reached depend largely upon the point of view. The large mine operator, who buys and opens, but who does not discover or locate, mines, upon whose shoulders falls the burden of the costs of litigation—he, with his lawyers and his surveyors and his experts, usually leans toward the 'square location'. The prospector and the discoverer feels in his every fibre, no matter what fictitious sacredness judicial construction of the statute may have thrown about the idea of the surface, that the lode itself is the only real property, as it is the only thing he has been hunting, and when he finds the lode his desire 'to stay with it till it reaches hell' is a passion that cannot be understood by one who has never owned a lode mine and worked in it, or who has never lived in a mining community. The discoverer is not of the class that has usually had to bear the costs of mighty lawsuits, and therefore he loses no sleep over the possible litigation. And, even if he does take the chance of losing the mine, he is willing to do so with the same cheerfulness with which he spent the greater part of his life on the chance of finding it. As long as the law recognizes his right, he is willing to take his chances of being able to hold on to the lode. He has long learned to look upon mining with the same game philosophy with which John Oakhurst looked upon life: as at best an uncertain game, and to 'recognize the usual percentage in favor of the dealer'."

JOHN F. DAVIS.

San Francisco, August 8.

The Editor:

Sir—I have read the proposed revision of the mining laws, and as you kindly stated in your issue of June 18 that you would be glad to hear from your readers, I venture to submit my views on the matter.

I am always in favor of any progressive legislation, also of any reform that is the good of the greater number, but I am far from being in accord, specially on some points, with the proposed revision initiated by the committee appointed by the Bureau of Mines.

Sec. 5-A, Locating on Cardinal Lines:

That feature of the proposed revision is next to impossible, from a practical point of view. It is absurd to locate on cardinal lines in conformity with the system of public land surveys, even on surveyed land, unless we want to drive the legitimate prospector from the field altogether. It is deplorable that Nature, in creating lodes and mineral deposits, was not accommodating enough to lay them parallel and on cardinal lines in conformity with Uncle Sam's surveys.

To be explicit I will cite instances that demonstrate without a doubt the unreasonableness of the demand that the legitimate prospector locate on cardinal lines. We, right here, are on surveyed land, and two years ago a local mining association ventured to locate a water-right to generate power to run a mill that was being built on the river; and in order to do so, with the application they had to furnish the Water Commission with a survey of the ditch, the points of diversion and distribution, the engineer's field-notes, etc. Their engineer was on the ground with a crew of men; all went on a hunt for a corner-section monument; they hunted for a week, but they did not find one; so finally they concluded to tie up to a patented claim about a mile away. How long would it take a prospector with a four-bit compass in his pocket (as a rule it is as good as he can afford) to find a corner monument? He could not tie to the patented claim, for it was not located on cardinal lines.

Another instance. This spring a railroad company, the Yosemite Valley Railroad, ventured to run a survey up the river for a proposed line. F. M. Woodman was the engineer in charge. With a crew of men, and armed with a transit, maps, and all the guides and references available, after days of hunting and brush-cutting they finally found what purported without a doubt to be a section-corner. Mr. Woodman will verify my assertion. He is connected with the Y. V. R. R. and Yosemite Lumber Co., of Merced Falls, California.

I have been here and owned claims here for ten years. While I knew I was on surveyed land, I did not know the whereabouts of one corner monument in the county. None of my neighbors knew of the whereabouts of such a monument, and some of them had been here much longer. These are samples, and samples of the whole mining country in general. That ought to be enough to convince any sane man of the absurdity of locating on cardinal lines.

Section 5-B, Subject to Limitations:

I fail to see what good it can do to give the right of location without discovery, and I know that in many cases it would do much harm. It is a known fact that there are two classes of prospectors: The Roughneck who does all the original locating in a new area and digs all the first holes, but does not at any time locate anything unless he makes a discovery. If he does succeed in making his prospect attractive it is only a matter of a short time before he will be at the end of his rope and must do something toward getting financial help. There is one course open for him: to sell the control, but by doing so as a rule he is left to stick around for awhile, then kicked out, or 'frozen out', as it is generally called. That is when the other class of prospector comes in. And to make it short and explicit, let us call this class the Highbrows. It is in this class that the committee of the select few who initiated this proposed revision belong, and it is only for their selfish interest that it should be enacted. The other course for the Roughneck is to take the few paltry dollars that the Highbrow offers him, and for safety as a rule he takes the latter course; he takes the few dollars and settles with the storekeeper and buys a few necessaries and then goes to some favored spot to hunt for another prospect.

By all means let us have it that a discovery is a condition precedent to the location of a mining claim.

As the draft reads, I presume that the committee had in mind that possibly in some cases the prospector might venture to do his prospecting for discovery with a diamond-drill. I do not see any objection to that, but let him do his drilling before he locates. The right is given to hold a claim classified as mineral for five years without discovery and then the prospector or locator would have his time extended for five years more, by payment into the U. S. Land Office of $50 for each acre or fraction thereof. Where is the legitimate prospector that could pay $50 per acre per year or $2000 per year in advance? The average legitimate prospector has not enough to buy beans for a month in advance. It is ridiculous.

According to Section 5-G: Final entry and payment shall be made for all mining claims within seven years from the date of the original location. This would compel the prospector to take the few dollars he is offered within seven years or lose all, for very few would have the money for final entry and payment, although he always has the time to represent.

The longer a claim is held before final entry the better it is for the development of the mining industry, for $100 has to be expended in improvement or development, and as proof I'll say this: I know in the Ubehebe country where there is a group of 14 claims that have been patented for many years on which there is ore that assays as high as 12% copper, besides other values, and they are not worked. The owners own other copper properties and thereby limit the output.

Section 6-B, pertaining to paying the money into the U. S. Land Office in lieu of development or improvement. The only good that could do would be to create a position for three-buckle high-boot man, who probably would get the position for services rendered; or, in other words, to liquidate a political debt, and he could come over and look up a discovery for Mr. Highbrow. Let the amount be expended in labor or improvement; as already stated, Mr. Highbrow doesn't like to dig. Well, Mr. Roughneck will do his digging for him. He needs that money to buy beans and powder to do his own representing.

Section 7, pertaining to lateral rights: I believe that something should be done to eliminate so many lawsuits caused by apex splits, but by enacting a law to that effect we may get rid of one evil only to create another; what

will become of the apex lawyers and expert-testimony men? As a rule in an apex suit both sides are fat financially and they can well afford the expense: and those fellows have to live, somehow, but as I am not fighting the lawyer's battle in this matter, I will let them do their own fighting; it is up to them. There is a law in British Columbia that was enacted in 1896 and seems to have given satisfaction ever since. A full claim is 1500 ft. square and the right of the apex does not extend beyond the vertical planes of the surface lines, but not on cardinal lines in conformity with the Dominion survey, mind you. Why not copy it to the extent that suits us? You may say that we ought to draft our laws without having to borrow from a neighboring country. I think so myself, but not in that select committee of the few, as so far demonstrated at least; but I am more inclined to think that the brain was not lacking so much; they were merely ruled by their sordid selfishness.

As a summary of the whole: there is no improvement in the proposed revision with the exception of lateral rights. Our mining laws are pretty good and fair to all those concerned as they now stand; and if our lawmakers see fit to change the extra-lateral rights to one more feasible and one that would protect the rights of all concerned, good and well. That could be done with an amendment to the existing laws without repealing practically the whole law and be substituted with this narrow and vicious proposed revision as drafted by this select committee of the few. Now, Mr. Roughneck prospector, do your duty and bombard your respective Senators and Congressmen with protests against this vicious proposition. You are in the majority, and every one of your votes counts one on election day, the protests should be so numerous that our lawmakers would not dare to pass the law as drafted; even of they were inclined to be in favor of it. But if you sleep on the job, then do not blame the lawmakers when it is too late, for they are not all versed in the science of prospecting. Therefore enlighten them.

EMILE M. RENAUD.

Coulterville, California, July 10.

The Editor:

Sir—The proposed new mining law does not, in my opinion, deserve the wholesale condemnation given it by W. W. Rush in your last issue, nor do I think that L. I. Manson can be taken seriously when he says "the side lines of all lode-mining claims shall run parallel with the dip of the vein, to its entire depth". Surely, if Mr. Manson has had any experience with a complicated vein system, he must know that this would be an impossible adjustment. The "gold old mining code" can scarcely be said to "have withstood the test of time"; rather I should say that it has been tolerated and will soon be amended so as to meet present-day requirements. I agree with him that the payment of a tax of $5 per acre, in lieu of assessment work (honestly performed) of $100 per claim, each year, would be a pernicious change, tending to slow up and even, in some instances, prevent the development of mining claims, which, at best, is now hampering the mining industry. There is indeed the danger that he senses in Section 13, under B, in regard to the conveyance of lands which are under the control of the Forest Service and it is to be hoped that this feature of the bill will be eliminated.

If the public at large is as suspicious of the mining engineer as Frank P. Davis seems to be (in your issue of July 16) we must be a scaly lot; and Mr. Davis must be poorly advised, if he thinks that the law is to be retroactive in its provisions. In the same issue, the comment of L. C. Denny is intelligent and pertinent, and I hope that such criticisms will reach the attention of the Committee. There is little doubt but what a provision requiring conformity with the public land surveys, for all lode claims, would result in more confusion and overlapping of claim lines.

With underground rights bounded by vertical planes, there should be no necessity for the orientation that is proposed; and this provision will probably be abandoned.

San Francisco, July 30. F. L. SIZER.

Quicksilver

The Editor:

Sir—During the War the Government made frantic efforts and expended vast sums of money to force productivity of quicksilver in the United States, which but few outside the scientific bureaus at Washington knew existed in this country. It developed at the U. S. Tariff Commission meeting held at San Francisco during the last days of the War that America in producing quicksilver could not compete with the high-grade ores and cheaper labor of Austria, Italy, and Spain. In normal times the average cost of producing the metal in the United States was between $70 and $75 per flask of 75 pounds. Quicksilver was the only metal that the War Board agreed to protect with a tariff after the War, and that was done for the purpose of impelling the mine operators to put this industry on a permanent basis in developing their deposits.

The greatest menace to the quicksilver industry in this country is the Almaden mines in Spain, which yield mercury from ore averaging about 11%, at a cost of $16 per flask. The ore-reserves at Almaden are good for 40 years, on a basis of an output of 1000 tons of metal per annum. These deposits are owned by the Spanish government, and operated with convict labor. The entire output of this mine is contracted to the Rotchschilds in London at £7 sterling per flask of 75 lb., and this concern has the privilege of regulating the output of the mines.

Why then should foreign concerns—in this case, only one foreign concern, namely, the Rothschilds, who control 74% of the quicksilver output of the world and manipulate the market as they wish, snapping its fingers at those who are trying to develop the industry in this country—be allowed to directly control our prosperity? They are able to produce as much or as little quicksilver

as they like, and thus keep the price where it best suits their needs. They unload their product in this country when the value goes high enough over what they can obtain in Europe. It may be seen, in this wrecking process practised by this concern, that it is the producer in this country who suffers the decline only to have the same conditions repeated after a rise. How can the American people feel that they are benefited by the establishing of free quicksilver? No one pays for it except American industry and we as a people might as well keep the money at home by placing a tariff on quicksilver, stabilizing the market and developing our own resources.

Up to the present time California contributes more than half the quicksilver produced in the United States. Oregon and Nevada have a few producing mines, while Texas produces about a quarter of our quicksilver. The average grade in California and Texas is less than 0.01%, or less than 20 lb. per ton of ore. The Spanish carries 14%, and subsidiary orebodies 0.02½%; the Italian about 0.01%; and the Austrian 0.85%.

The great cinnabar lodes extending from out of northern California into and through southern Oregon average less than 0.01%, but these lodes are rich in chimneys or pay-shoots that produce ore that reduces to as high as 70% in large quantities. The small furnaces and properties during the war period in the Gold Hill district averaged 17%, while over in Douglas county the operators find conditions about the same as here in Jackson county, but less rich in pay-shoots.

Everybody will not admit that a tariff always has the effect of raising prices. If properly applied, it will permit industries to be developed in this country that cannot compete with powerful industries of the same kind in foreign countries; and it is reasonable to believe that a fair percentage of them will reach a point where they can compete. It seems to be regarded as an economical essential that a country should develop and have at its command all its resources. Competition means reduced prices. Let us have competition.

A. E. KELLOGG.

Gold Hill, Oregon, July 14.

[Reference may be made to the comprehensive article on the Almaden quicksilver mine by Mr. H. W. Gould that appeared in our issue of April 23. Mr. Gould speaks of strikes among the workers, but not of convict labor.—EDITOR.]

Treatment of Zinc-Silver Ore

The Editor:

Sir—I have to thank Mr. D. W. Brunton for his reply to my question whether chloride of zinc is a solvent for chloride of silver, but the question remains unanswered except in a general way. This is not an academic question, but one of practical importance, for we often have mill products that are at present valueless, as for example an oil-flotation zinc concentrate containing from 10 to 50 oz. silver, but too low in zinc for marketing. If zinc chloride were an efficient solvent of silver chloride the process patented by Mr. Brunton in 1880 might solve the problem. To be specific, we quote from the patent:

"2. In the process of leaching silver chlorides, the method of obtaining a solution of the chloride, consisting of roasting the ore in fine division at a low temperature [with salt presumably] and dissolving the base metal chlorides from the body of the roasted ore and adding this solution to the ore containing the argentic chloride."

To apply Mr. Brunton's method, the roasted chloridized ore is thrown into a vat of water (or brine) when hot. The silver dissolved may be precipitated by metallic copper, sodium or calcium sulphide. In Mr. Brunton's reply he says "that the solvent power of the salt solution was increased whenever the ore before chloridizing contained blende, by the presence of chloride of zinc and incidentally by the chlorides of calcium or potassium". We infer from this that the presence of the blende, which was converted into zinc chloride, increased the solvent power of the salt solution; therefore, in the treatment of a blende concentrate, the zinc chloride would be produced in relatively great quantities, and the salt solution should be very active.

Experiments I have conducted along these lines indicate that pure zinc chloride is not a solvent of chloride of silver; and an economical recovery of silver from an oil-flotation zinc concentrate by this process remains to be proved. I acknowledge that my experiments have not covered the many possible variations in roasting and leaching. The field is a promising one for the student, particularly in relation to chloridizing roasting and chlorination. We know that oil plays havoc with the cyanide process when treating a flotation concentrate until the hydrocarbons have been completely oxidized; but, theoretically, the carbon left in an oil-flotation concentrate after roasting at a low temperature should have no detrimental effect on the subsequent leaching with salt or hyposulphite, but it may.

The widespread use of the flotation process, particularly in regions remote from transportation, has given rise to new conditions; and it may be that these old processes, which were economically unfitted for the treatment of ores, may be of use for treating a small bulk of concentrate. Silver chloride dissolves in alkaline chlorides $Hg(NO_3)_2$, ammonia, soluble thiosulphates and sulphites (hyposulphites), in ferric chloride, in concentrated HCl, and as claimed by Mr. Brunton by the "base metal chlorides formed in roasting the ore".

Vogel gives the following table of solubilities of AgCl:

100 cc. saturated solution			$BaCl_2$	0.0143	gramme AgCl
"	"	"	$SnCl_2$	0.0884	" "
"	"	"	$CaCl_2$	0.0930	" "
"	"	"	$MgCl_2$	0.1710	" "
"	"	"	NaCl	0.0950	" "
"	"	"	KCl	0.0472	" "
"	"	"	NH_4Cl	0.1575	" "

From these figures we see that $MgCl_2$ is nearly twice as strong a solvent as common salt, NaCl.

In the Augustin process the roasted ore was heated with a 5% solution of NaCl, the AgCl extracted with

hot saturated solution of NaCl, and the silver precipitated on copper. The Percy-Patera process improved the Augustin process by using the solvent power of sodium hyposulphite, instead of salt, and precipitated the silver with Na_2S, thus regenerating the hyposulphite. The Russell process made use of sodium thiosulphite and cupric sulphite, which it is claimed is a solvent of silver chloride, metallic gold, and silver as also the sulphide, arsenate, or antimony of silver.

It is to be hoped that others will join this discussion, because it opens a new field for those who have been unable to treat middling flotation concentrates.

Nayarit, Mexico, July 12. ALGENON DEL MAR.

Stocks and Prices

The Editor:

Sir—Anent the 'Hints to Speculators and Investors in Mines', which appeared in your last issue, I am led to make the query of how many investors in this present day take without question the advice of such a market-letter as the last one of Hayden, Stone & Co. under date of July 22, wherein they say with reference to a substantial dividend-paying copper property, "It would seem fairly reasonable to count on a production of 75,000,000 lb. per year from this property, at a *profit*, with a full demand for copper, of at least six cents per pound".

This prediction, after just stating, in a preceding paragraph, that the estimated cost of production of this very same company—last year—was 12½c. per pound, and this one of the *lowest* cost that was reported.

I am inclined to think that the Cornish book, published in 1857, is still a good guide, especially the advice set forth in Section 13, rather than the average market-letter of an interested broker. While it is acknowledged that the future demand for copper will be very large, the wiseacres refrain from giving us even a guess as to the price of the metal at this time next year. More accuracy as to the surplus stock of the metal would be welcome.

San Francisco, July 29. F. L. SIZER.

'Pyrites' and 'Pyrite'

The Editor:

Sir—I note a brief letter from Mr. Walter W. Bradley in your issue of August 6, together with an editorial note commenting on the distinction between these two words. The discussion raises some interesting points. Had Mr. Bradley not written the last paragraph, his letter would have been unimpeachable so far as his ideas of 'pyrite' and 'pyrites' are concerned. In the last paragraph, however, he reveals the fact that he considers 'pyrites' ('pie-rie-tees' presumably) to be the plural of 'pyrite'. If he had had 'pie-rights' in mind he would not have been so precise in his use of the terms in the preceding paragraphs of his letter.

You are quite correct in stating that pyrítēs is not the plural of pyrite; but beyond that point I find myself unable to agree with you. I submit the following contentions, which I have numbered for the convenience of anyone who may wish to set me right if I am wrong.

(1) You say "Modern mineralogy has accepted 'ite' as the usual terminal and pyrite has been introduced in compliance with the custom". The inference is that 'pyrite' is a modern substitute for an obsolete pyrítēs. I cannot agree with this. Pyrite is the name of a distinct mineral, containing 53.4% sulphur and 46.6% iron; its chemical composition may be expressed by the symbol FeS_2. It has characteristic physical properties; the word represents a definite substance, precisely as does the word 'gold', or the word 'calcite'. Pyrítēs, on the other hand, is the name that may be applied to any one of a group of minerals, a number of which are named by Mr. Bradley. It is comparable with jelly; for example we have plum and apple and currant and raspberry varieties. Pyrítēs is generally singular in number, but it may be plural; there is a mineral sometimes called copper pyrítēs (singular) and one called arsenical pyrítēs (singular); these are two of the many kinds of pyrítēs (singular); or it would be permissible to say these are two of the many pyrítēs (plural).

(2) You say that "It [pyrite] has the advantage that it gives a plural". I venture to say that 'pyrite' has no plural except in the sense that 'gold' or 'calcite' or 'iron' may have a plural. One might say (but probably would not) that the gold from Alaska, that from California, and that from the Rand made three different golds. Some similar statement is the only kind in which a plural of 'pyrite' can be used correctly.

(3) You say, "Yes, there are several kinds of pyrite . . . ; the others are copper pyrite, arsenical pyrite, etc." Again I demur. There is only one kind of 'pyrite' for there is only one 'pyrite'. To designate chalcopyrite as 'copper pyrite' would be exactly analagous to using the expression 'copper calcite' when malachite is meant. It is correct, however, to say 'copper pyrítēs' for chalcopyrite, just as it is correct to say 'copper carbonate' for malachite; this last is correct but not precise, for the reason that azurite might be meant.

(4) 'Iron pyrite' is like 'lime calcite' or 'golden gold'. 'Iron pyrítēs' is correct, but inaccurate; as Mr. Bradley points out, it may mean either pyrite or marcasite.

I have ventured to trespass upon your space in discussing at some length a rather trivial point because I know that you are an advocate of precision.

San Francisco, August 7. MINERALOGIST.

THE graphite industry during 1919 was affected by the cautious readjustment in the business world that began after the War, by modification or repeal of war-time commercial regulations, and by the usual uncertainties preceding a presidential election, states a U. S. Geological Survey bulletin. Marked depression was the consequence. The total sales of domestic natural graphite were 7422 short tons, valued at $778,857, a decrease of 43% in quantity and 49% in value from the sales in 1918; but the business done was nevertheless of larger value than in any year prior to 1916.

Distillation of Oil-Shale

By David E. Day

The major operations in a plant producing oil from shale are: (1) mining and crushing the shale, (2) treating the shale to recover the oil, and (3) refining the oil into marketable products. The first and last of these operations present no new features. Although the mining of oil-shale may not be directly comparable to any particular type of mining, the general field of mining engineering is so broad as to cover almost any special case. Thus, though it cannot be definitely stated that long-wall or open-cut, or stoping methods will be required for oil-shale mining in general, when the specific mining conditions have been determined for a particular shale mine, practice standardized in other mines will be found that will fit those conditions closely. The same is partly true of methods for refining the crude oil, which differs essentially in chemical composition from any natural 'crude'; and, accordingly, the products refined from it differ from ordinary petroleum products. This difference will necessitate some changes from the present refining methods, but these changes are unimportant. Petroleum technologists are practically unanimous in the opinion that the refining of shale oil offers no insurmountable difficulties.

There remains only the problem of producing the oil from the shale—a problem that does not present any serious difficulties, but one that at present retards the operations of those who believe that the time for oil-shale development has arrived. Except in isolated instances, the only commercial method of recovering oil from shale is by means of a carefully regulated heat treatment. Although the condition in which the oil-producing substance exists in shale is not definitely known, it is almost certain that it is an exceedingly complex hydrocarbon. This hydrocarbon may be composed of relatively unaltered organic matter deposited with the shale, it may be liquid oil retained in the pores of the shale, or it may be the inspissated remains of originally liquid oil. Whatever its origin, the hydrocarbon is exceedingly complex; it cannot readily be dissolved and extracted by solvents; it adheres too closely to the shale to permit mechanical separation. There remains only the method of vaporizing this hydrocarbon, and condensing the vapors formed. In all probability, the original hydrocarbon is so complex or so tightly bound in the shale pores that it will not distil without 'cracking'. This contention accounts for the residue of carbon in the shale, for the amount of fixed gases formed, and for the presence of such a large percentage of unsaturated hydrocarbons in the recovered oil. Assuming that this theory is correct, and that a 'cracking' distillation is the only method of recovering oil from shale, the problem resolves itself into the controlled-heat treatment of a fragmentary material.

Early in their connection with oil-shale problems, the engineers of the Day Co. decided that retorting offered a wide field for the application of technical skill and experience; they felt that many of the retorts designed were not sound from a mechanical point of view. It appeared that the only logical method of solving a problem of this sort was to establish the technical principles involved, so that the general type of apparatus required would be evident; a study should then be made of analogous industries, so that the apparatus used should conform with standard engineering practice.

By the principles of retorting shale for oil is meant those that are involved in producing oil as the main and most important product. By-products introduce separate factors, which necessitate separate discussion. In this article the oil-shale retort will be treated as a machine for producing oil, and oil alone. The factors governing the efficiency and economy, and oil-recovery of a retort, considered from the standpoint of the retort alone and ignoring the factors introduced by the type of shale or its preparation before retorting, are as follows:

(1) Factors affecting efficiency:
- (*a*) Thin shale layer.
- (*b*) Mechanical agitation.
- (*c*) Complete heat control.
- (*d*) Efficient application of heat.
- (*e*) Efficient furnace design.
- (*f*) Simple mechanism.
- (*g*) Large unit capacity.

(2) Factors affecting economy:
- (*a*) Continuous operation.
- (*b*) Minimum number of moving parts.
- (*c*) Maximum use of automatic machinery.
- (*d*) Minimum fuel requirements.
- (*e*) Accessibility of parts.
- (*f*) Mechanical strength and endurance.

(3) Factors affecting the quantity and grade of oil recovered:
- (*a*) Temperature control.
- (*b*) Even heat application.
- (*c*) Progressive heating.
- (*d*) Protection of vapors from abnormal temperatures.
- (*e*) Free passage of vapors.
- (*f*) Freedom from dust.

Factors Affecting Efficiency

Thin Layer of Shale. The necessity for a thin layer of shale in the retort is due to the insulating qualities of the spent shale. Because of its high porosity and carbon content, spent shale is one of the best of insulating materials. A thickness of ten inches of spent shale is equal in insulating qualities to a two-course wall of fire-

brick. If the shale layer heated is thick, that portion of the layer lying nearest to the heating surface will be distilled quickly and easily, but this spent layer will insulate effectively the portion of the shale lying farther from the heat, and will make distillation exceedingly slow and difficult. This explains one of the faults of the Pumpherston retort in its application to American shale. This retort is circular in cross-section, with a diameter of 22 in. at the top and 26 in. at the bottom, and is heated from the outside. The minimum shale layer is therefore 11 in. thick. Experiments showed that it was relatively easy to distil the oil from the four-inch zone nearest to the retort, but that the complete disillation of the material lying within this zone took nearly four times as long as was necessary for the material in the outer zone, and necessitated a correspondingly larger amount of heat. A thick shale layer also affects the quantity and grade of oil recovered, and will be discussed under that head.

Mechanical Agitation.* The agitation of the material as it passes through the retort is important, both from the standpoint of heat efficiency and operating efficiency. It is obvious that a greater shale layer may be retorted with the same amount of heat and in the same time, provided that it is constantly stirred and agitated, than would be possible if it remained stationary. The effect of this agitation is to remove constantly the spent material and to substitute fresh in its place, thus avoiding the insulating effect of a stationary layer of spent material in contact with the zone of heating. Furthermore, most rich shales tend to coke in the retort unless they are subjected to constant agitation. In the retorts of the Scotch type, where no mechanical agitation is used, and gravity alone is relied upon to carry the shale through the retort, rich shales coke, and adhere to the sides of the retort; they clog the apparatus and cause expensive shut-downs and repairs. Mechanical agitation has a decided effect on the quantity and grade of oil recovered and will be discussed under that head.

Complete Heat Control. The importance of complete heat control is so obvious as to require little discussion. If too little heat is applied the time of retorting will be increased, with a loss in retort efficiency. If too much heat is applied, some of the oil will be lost as permanent gas, and heat will be wasted, thus reducing both operating and heat efficiency.

Correct Applications of Heat. Not only must the heat be under complete control but it must be correctly applied. To achieve high efficiency, shale should be heated progressively to higher and higher temperatures; the greatest heat should be applied at the discharging end of the retort, and should decrease gradually toward the charging end. Furthermore, heat should be applied so that each particle of shale receives the same heat treatment. Careful retort design is necessary to produce this result. Another question worthy of consideration is the relation of the area of effective heating surface to the total surface of the retort and to the tonnage treated in one charge. Many of the retorts are inefficient because the effective heating surface is only a small percentage of the surface actually heated. This is particularly true of horizontal and cylindrical retorts, where heat is applied to the entire circumference of the retort, whereas the effective heating area is limited to a relatively small arc on the bottom.

Correct Furnace Design. Too little attention has been given to the furnace in which the retort is placed. This furnace should not only be designed to regulate and apply the heat as discussed under the last three headings but should also be designed with attention to the general principles of furnace efficiency.

Simple Mechanism. The simpler the mechanism, the lower the cost of installation and of upkeep and operation. Many retorts that produce good results in the laboratory are totally unfitted for commercial operations because of the complication of their mechanism. It must be remembered that a commercial shale plant must be capable of handling large tonnages continuously. Any retort in which the mechanism is complicated needs frequent repair; shut-downs and the resulting loss are inevitable. Moreover, the retort will be subjected to a temperature at which iron will not withstand great stresses, so that metal moving parts subjected to heat cannot be expected to withstand the severe operating conditions.

Large Capacity. In designing an oil-shale retort, or in considering the adoption of a process, the primary consideration should be the adaptability of the retort to large-scale operations. The oil-shale industry is fundamentally a low-grade mining enterprise. To be commercially successful it must handle large tonnages at low costs. For this reason any successful retort must not only be adaptable to large-scale development, but must be capable of attaining this development without too great a duplication of units. It has been emphasized before that the construction of a successful experimental shale-retort is not a difficult matter, but that duplicating the results on a large scale is another problem. It is not beyond the powers of a good engineer to grasp quickly the potentialities of a retort from this point of view, and it is surprising how often this fundamentally important factor is overlooked.

Factors Affecting Economy

Continuous Operation. Continuous operation is essential, not only from a standpoint of efficiency but to secure economical operations. No matter how ideal a batch type of retort may be from an efficiency standpoint, it can never be as economical as a correctly designed continuous retort. The time required to empty and recharge a retort of the non-continuous type is a total loss; even if this period consumes only ten minutes of every hour, such a retort would be idle for 16⅔% of the time, or 50 days out of a 300-day working year. Heat is wasted during the idle period if the retort is kept hot, or an

*'Agitation', in the sense used in this discussion, means slow irregular movement, both lateral and vertical, rather than violent motion.

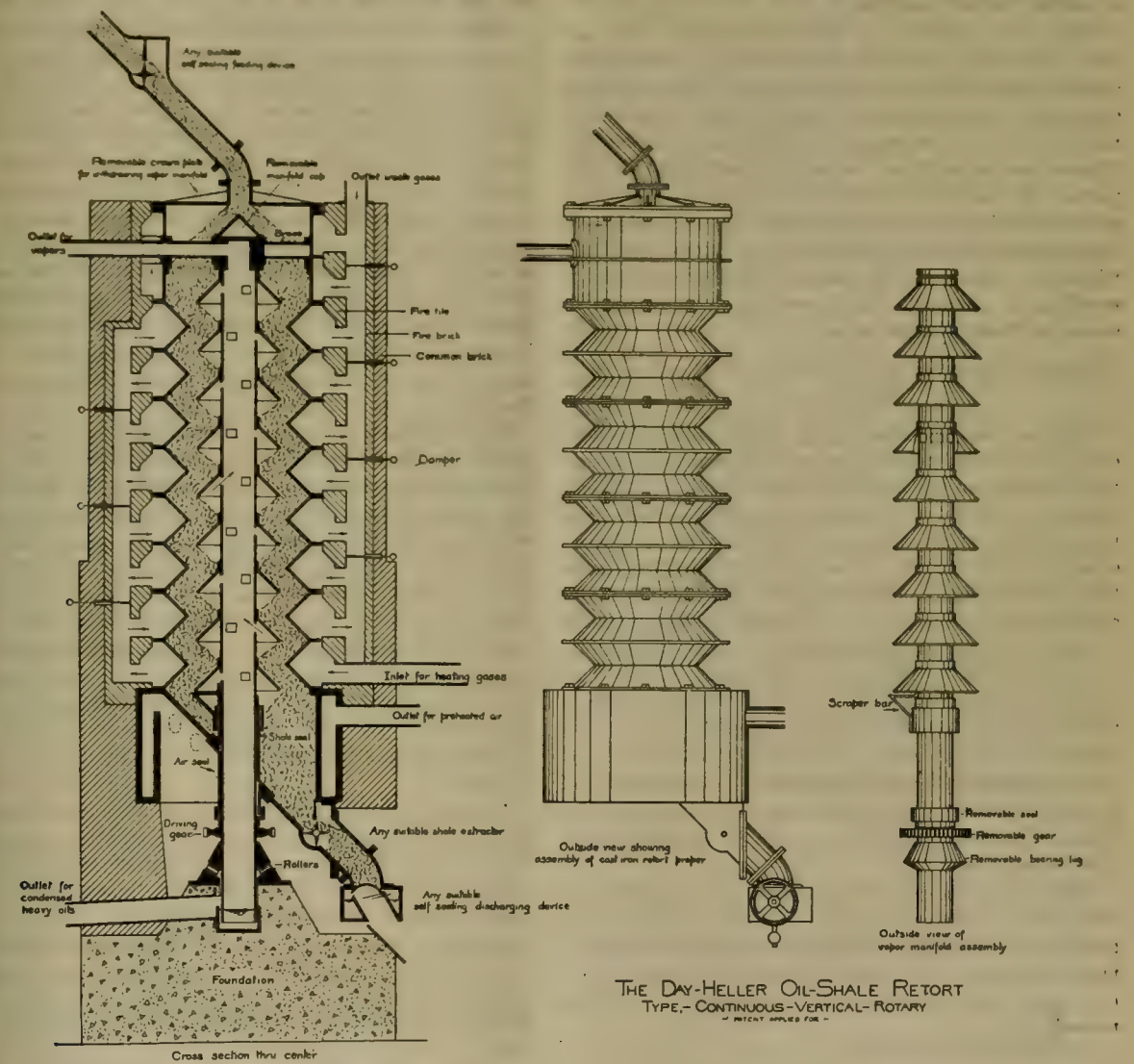
excess of heat is required in starting if it is allowed to cool down. A non-continuous type of apparatus cannot be made as nearly automatic as a continuous retort, and consequently requires a greater labor and superintendence charge per ton capacity.

MINIMUM NUMBER OF MOVING PARTS. The number of moving parts required should be kept at a minimum not only for the reasons discussed under efficiency, but also for reasons of economy. In the first place, these parts require power to operate them, and this means expense. In the second place, moving parts are always subject to wear, and in course of time will need replacing. The relation of moving parts to high temperatures, as already discussed, is an important consideration.

MAXIMUM USE OF AUTOMATIC MACHINERY. The effect of automatic machinery on the economy of operation is too well-known to require discussion. This factor has perhaps been over-emphasized by many inventors, who in their attempt to make an entirely automatic retort have defeated their own purpose by introducing an impossible amount of complicated machinery.

MINIMUM FUEL REQUIREMENTS. It is obvious that to obtain operating economy, fuel requirements should be kept at a minimum. For this reason full use should be made of all possible heat applied (1) by designing an efficient furnace, (2) by controlling the heat applied, and (3) by recovering some of the heat at least from the spent shale and the vapors. It is, of course, impossible to recover all the heat applied during the operation, but it is unnecessary to waste it all. The heat in the spent shale may be used to pre-heat air for combustion or in the production of producer-gas; the heat in the vapors may be recovered to some extent, by the use of heat exchangers, in pre-heating the incoming shale. Very little thought has been given to this subject, which will have an important bearing on economical operations.

ACCESSIBILITY OF PARTS. The entire retort should be completely accessible. Shale may tend to coke or clog



THE DAY-HELLER OIL-SHALE RETORT
TYPE,- CONTINUOUS-VERTICAL- ROTARY
- PATENT APPLIED FOR -

the retort, or carbon may form on the walls. Consequently, access to the interior should be provided so that the walls may be scraped or cleared if necessary. The furnace should be so designed that damaged or burnt-out retorts may be replaced without tearing down the brick-work. Finally, if any dust is formed in the retort, it may be carried over by the vapors and deposited in the vapor lines. For this reason these lines should be arranged for easy cleaning.

Mechanical Strength and Endurance. The last and, possibly, the most important factor is the mechanical strength and endurance of the retort. No matter how sound and perfect a retort may be from a theoretical point of view, it is worthless unless it can withstand continuous service without excessive repairs and replacements. To accomplish this result the parts subject to stress must be protected from heat, moving parts and complications must be reduced to a minimum, and the whole structure must be designed with a clear understanding of operating conditions and a knowledge of sound mechanical construction.

Factors Affecting the Quantity and Grade of Oil Recovered

Temperature Control. If the theory that oil is produced from shale by 'cracking' complex hydrocarbons, already existing in the shale, is adopted, the importance of complete temperature control is at once evident. Experiments have proved that radically different results are obtained when shales are treated at different temperatures. When high temperatures are used a large amount of light oil is produced at the expense of a lessened total recovery. When low temperatures are used, a maximum amount of oil is recovered, but this oil has a small percentage of low boiling hydrocarbons. Market conditions will determine the product from which the greatest net return can be expected. To recover this product, the range of temperature necessary must be determined, and the retort must be operated constantly at these temperatures. Absolute temperature control is essential in accomplishing this result.

Even Heat Control. Inasmuch as the use of different temperatures will result in the production of different grades of oil from the same shale, similar heat treatment must be given to each particle of shale in order to produce an even product and to avoid losses. This will necessitate

(1) A thin layer of shale.
(2) Mechanical agitation.
(3) Continuous treatment.

The thin layer of shale avoids over-heating of the shale nearest to the retort wall in the attempt to heat sufficiently the shale further removed. Mechanical agitation further reduces the effective insulating property of the shale layer, and makes even treatment of the individual particles possible. Uniform heating conditions can only be maintained by continuous treatment.

Progressive Heating. Experimental work and research have shown that to obtain a maximum yield of the most desirable product, the shale must be heated progressively. In practice the temperature of the shale should be increased gradually to the point at which oil vapors are formed, and then increased uniformly until all the oil is driven off. To accomplish this not only necessitates perfect control of the heat applied, but also involves the application of the most intense heat at the discharging end of the retort, with an even decrease to the charging end.

Protection of Vapors From Abnormal Heat. Shale vapors as formed are composed of complex molecules which are easily dissociated if exposed to temperatures higher than those at which these vapors were formed. Some of this breaking down or 'cracking' may be desirable for the production of light oils, but in any case it must be carefully controlled. In general, it seems essential to withdraw the vapors as rapidly as formed, and to protect them from high temperatures. If, on the other hand, the vapors come in contact with a layer of relatively cool shale, and are condensed and re-vaporized, a large loss will result, and undesirable hydrocarbons will be produced. Except in special cases, therefore, the vapors should be withdrawn without over-heating or re-distillation.

Free Passage of Vapors. One of the most essential factors in obtaining the result discussed above is a free passage for the vapors, not only in the retort itself but also from the retort to the condenser. Pressure in the retort is probably undesirable from the standpoint of products formed, and it certainly increases the difficulty of preventing leaks, particularly in a continuous apparatus. The use of vacuum, on the other hand, although theoretically desirable, introduces mechanical complications that should be avoided if possible. The best plan is to provide passages for the vapors that are sufficiently large to allow them to pass out freely without creating pressure in the retort and without necessitating the use of vacuum.

Freedom From Dust. Although, as already discussed, mechanical agitation is essential to successful retorting, this agitation should not produce dust by grinding the shale, nor should it tend to stir up the dust that may be present with the crushed shale. Shale dust, if given the opportunity, will go over into the vapor lines and condenser with the vapors, and will absorb oil to form a thick paste, which not only clogs the lines and causes countless mechanical difficulties, but also wastes a large amount of oil.

The Retorting Apparatus

The determination of the factors just discussed indicated certain features essential to the retorting apparatus. It is directly evident that the retort should be continuous, it should be capable of complete temperature control, it should agitate the shale, it should treat the shale in a thin layer, it should heat the shale progressively, it should avoid dust, it should be simple mechanically, it should be of large capacity, and it should be strong and durable. It also indicated that the retort should be vertical because of the mechanical difficulties

involved in externally heating a horizontal retort. In a vertical retort, the stresses all act downward on a firm basal support, whereas in the externally-heated horizontal retort, these stresses are balanced only at the points of support and the unbalanced stresses between these points cause the retort walls to sag and to twist out of shape.

Consequently, the study of apparatus used in other industries that may be applied to oil-shale work is limited to continuous and vertical furnaces that are capable of applying a carefully regulated heat to a fragmentary material. The industries that immediately suggest themselves as analagous are those connected with oil-shale operations in other countries, the by-product coking of coal, and the heat treatment of ores in roasting-furnaces.

Roasting Practice. The type of furnace developed for roasting ores is well adapted to the problems encountered in that industry, and presents good data on the mechanical methods of heating crushed material. Certain differences in the technical problems encountered prevents its adaptability to the retorting of oil-shale. The majority of such furnaces are direct fired; the hot gases act directly on the material to be treated. This results in a high heat-efficiency but also involves the use of a gaseous heat medium that will mingle with the vapors produced from the shale. If this heat medium is composed of ordinary furnace gases, a certain amount of unreduced air will enter the retort and will oxidize a part of the oil. If this heat medium be an inactive gas, such as the fixed gas produced from the shale, a large volume of it must be used in comparison with the vapors formed; and the problem of condensing a fairly small amount of vapor from a large amount of permanent gas is a difficult one. Furthermore, roasting-furnaces of the multiple-hearth type require comparatively finely crushed material, and the dust produced as this falls from hearth to hearth will constitute a problem.

By-Product Coking and Scotch-Shale Practice. The shale industry in Scotland and the standard methods of by-product coking may be considered together, inasmuch as the coke-ovens were developed from the Scotch-shale retort. The retort generally used in both these industries is vertical, with a round or oval horizontal section. Coal or shale is fed at the top of the retort, passes through the heating zone, and is continuously removed at the bottom. Mechanically, this type of retort has been developed to a high state of perfection, but technically and economically it is open to objections. The most important defects are the thick layer of material treated and the lack of mechanical agitation. Furthermore, it has been found that rich shales will sometimes coke in a retort of this type, where no mechanical agitation is introduced. In experiments conducted with a Pumpherston retort at Autun, France, in the distillation of rich Australian shale, the coking effect was so serious that the apparatus was considered unsuited for the distillation of shales carrying more than 30 gallons to the ton. There appears to be little hope, then, of adapting Scotch practice, or coke-oven practice, to the American shale industry without important changes.

However, certain specialized apparatus used by the Germans in retorting brown coal seems to have a direct bearing on the problem. The Rolle retort, which is at present the most successful low-temperature apparatus for coal distillation, appeared to be particularly well adapted to oil-shale distillation. This retort consists of a vertical and cylindrical shell, to the exterior of which the heat is applied, and an internal structure of horizontal rings positioned concentrically in the retort, with their outer faces slanting downward. The space between the rings and the retort wall is filled with shale; the open space within the rings serves as a vapor passage. This retort is continuous and vertical. It treats the shale in a thin layer, and heats it progressively. It has no tendency to form dust, it is simple mechanically, and it has a large capacity. The only essential factors lacking are agitation of the shale and efficient temperature control.

The engineers in charge of this investigation for the Day Co. decided that this retort could be easily adapted to oil-shale retorting by introducing mechanical agitation and temperature control, and plans were immediately started to accomplish this step. The result is a retort which combines all the necessary technical factors, and is at the same time simple, strong, efficient, and of large capacity.

The Day-Heller Retort

The diagrammatic sketch shown herewith indicates (1) a cross-section of the complete assembly, with furnace and flues, (2) an outside view of the cast-iron retort proper, and (3) an outside view of the vapor-manifold assembly. It is seen that the retort is composed of three main parts: (1) the retort-shell, which may be made of cast-iron, cast-steel, or refractory material, (2) the vapor-manifold, and (3) the furnace.

Retort-Shell. The retort-shell is circular in horizontal section, and is composed of any number of units in baffled cross-section, as shown in the sketch. At the top, the retort is provided with a removable cover-plate, with an opening for admitting the untreated shale. At the bottom, there is a suitable shale-extractor and a double-walled chamber for pre-heating the air for combustion and for cooling the spent shale. This retort is vertical and stationary and is enclosed by a suitable furnace.

Vapor-Manifold. The vapor-manifold consists of a pipe upon which semi-conical baffles are mounted. Beneath the baffles are large perforations. This manifold is placed concentrically in the retort as shown in the drawing. At its upper end it engages a removable bearing brace, which connects the vapor-manifold to the condenser-line as shown. The lower end of the vapor-manifold protrudes through the bottom of the retort, with suitable seals for shale dust and vapors. On its lower extremity a removable bearing-lug is mounted, which, resting on a roller-bearing, takes the weight of the manifold, as well as the thrust exerted by the shale resting on the baffles. Above this bearing-lug is a split gear, by

which the entire vapor-manifold may be rotated. The position of the baffles on the vapor manifold with relation to the baffles formed by the walls of the retort is indicated in the drawing.

FURNACE. Surrounding the retort is a circular furnace, so arranged that a series of fire-tile forms annular flues with the indentations in the retort walls. Two diametrically opposed vertical flues permit the passage of the gases from one annular flue to the other, and also permit by-passing the heat to the point most needed.

OPERATION. In operation, shale is allowed to fill the space between the baffles on the vapor-manifold and those formed by the retort wall. The vapor-manifold is rotated slowly and constantly, and fresh shale is continuously added at the top as spent shale is removed from the bottom. Hot gases from any suitable type of fire-box are circulated in the annular flues, entering at the bottom, making a complete revolution around each flue, and leaving through the stack at the top of the furnace.

The shale enters continuously, and is spread in a thin layer over the baffles on the vapor-manifold and the retort wall. As it descends from baffile to baffile it is turned over and at the same time it is constantly agitated by the revolving vapor-manifold. The result is an even treatment of the individual shale particles, the prevention of coking, and exceedingly economical heating. The zig-zag form of retort walls produces a large heating area (nearly twice that of a cylindrical wall of the same proportion). Furthermore, these indentations in the retort walls form annular flues that can be maintained at any desired temperature, insuring perfect heat control. The vapors formed have only to reverse a very thin layer of shale before they reach the open spaces under the truncated cones on the moving manifold, and then pass through large perforations into the vapor-manifold proper, and out to the condensers. The baffles prevent shale particles from lodging in the perforations; for this reason these perforations may be made sufficiently large to permit easy passage of the vapors and to obviate clogging with dust. The vapors pass constantly into zones of temperature lower than that at which they were formed. As soon as they reach the vapor-manifold they are insulated from the furnace heat by the layer of shale surrounding them, and they then pass out through the top of the retort, giving some of their heat to the incoming shale, without coming into direct contact with it. At the base of the retort there is an air-jacket that cools the spent shale and pre-heats air for combustion.

Mechanically, the retort is extremely simple. There is only one moving part—the vapor-manifold—and this is strong and durable. It moves slowly, encounters no stresses acting directly against its motion, and is insulated from the heat. Access may be had to the complete retort by lifting the vapor-manifold out through the top. This can readily be done by unbolting the cover plate, by lifting the upper brace bearing from its lugs, and by removing the gear and bearing from the lower end of the manifold pipe. With the manifold removed, the retort is open for inspection and clearing. All the parts are standardized, and are interchangeable with similar parts in other units, so that by keeping a few spare parts on hand a large plant may be operated continuously without serious shut-downs and delays.

The furnace is designed particularly for high efficiency, economy, and complete control. The greatest objection to a vertical furnace is the difficulty of efficient heating. This has been overcome in this retort by using horizontal annular flues, which are separate and independently controlled by dampers. The retort has a high capacity compared to its bulk and to the ground space occupied. Thus a single unit 25 ft. high and 10 ft. in diameter, including flues, will have a capacity of from 100 to 250 tons per 24 hours, depending on the type of shale treated.

SPEAKING of the question of man-efficiency at a discussion of the paper of A. E. Pettit on 'Notes and Records of Mining Costs', before the Institution of Mining & Metallurgy recently, R. E. Palmer showed that, on the Witwatersrand, in 1894 the production was 70 tons per man per annum. This went on increasing, until in 1902 it was 80 tons, or an increase of nearly 13%. In 1903 rock-drills were introduced, and it would be interesting to know whether they were introduced for the purpose of reducing the cost of production with cheap labor, or for the purpose of replacing labor unobtainable. As the working costs immediately began to decrease it might be presumed that the introduction of mechanical drills accounted for a portion at least. As might be expected, the man-efficiency rose in 1904 to 103 tons per annum; and, as more rock-drills were added, this continued to increase until it reached a maximum in 1914: 153 tons per man per annum. The fact remained, however, that the Rand engineers had been able to increase the man-efficiency from 103 tons in 1904—a year after the introduction of rock-drills—to 150 tons in 1917, when the number of rock-drills was at a maximum, or an increase of about 40%. The working costs dropped from 24s.4d. to 19s.2d. per ton during the same period. In the Rand they had one type of labor, in Great Britain another, in India another, in Spain another, and in Canada or the United States another, and in Australia another; it was not to be supposed that, given the same conditions, the output, without undue use of physical force, would be the same. Still it should not be a great difficulty to group them according to their capacity, and expect an equivalent output from the members of each group. By altering conditions on the Rand the man-tonnage had been increased by nearly 40%, from 80.7 in January 1920 to 117.3 in July of the same year.

THE increasing production of zinc skimmings, ashes, hard zinc, and scrap zinc, from which zinc is recovered in the form of metal, alloy, pigment, or chemical, and so used again, affects the consumption of primary zinc, states a U. S. Geological Survey bulletin. The total quantity of secondary zinc recovered in 1918 was 120,590 tons, as compared with 116,200 tons in 1917.

The Volatilization Process at the Pope-Shenon Mine

By Robert H. Bradford

The Pope-Shenon mine is situated eight miles south of Salmon, in Lemhi county, Idaho. Prior to 1917 the company had developed a large tonnage of oxidized copper ore; it was for the purpose of devising a method for treating this ore that I was called into consultation at that time.

The results of extended tests demonstrated the feasibility of using some method of leaching, for the ore contains only a little calcium carbonate or other acid-consuming mineral. However, the distance of the property from sources of supply of scrap-iron for precipitating copper from the acid solution presented a serious obstacle to leaching. To erect an electrolytic plant seemed, in the light of current practice, at the time these tests were made, a serious venture; moreover, no large permanent supply of electric power was available in the region, and, during the War, prices for ammonia and acids rose excessively.

Inspired by the results of testing already done on lead and copper ores at our metallurgical research laboratory in the University of Utah, and by the results of volatilization tests previously carried out by other experimenters, including Stuart Croasdale, Selden I. Clawson, and Ben Howe, I recommended to the Pope-Shenon company that it send to the University of Utah a sufficient quantity of its oxidized ore to enable the making of complete volatilization tests for the extraction of the copper. These tests were commenced in June 1918, the metallurgical research department of the University of Utah and the Intermountain Station of the U. S. Bureau of Mines cooperating in the work. My tests on small amounts of ore were highly successful; the smaller tests led to larger ones; the equipment was extended and the final volatilization tests were made in a rotary-kiln furnace 20 ft. long, with an inside diameter, for two-thirds its length, of 13 in., and for the remaining third, at the fire end, of 22 in. Several tons of Pope-Shenon ore was used in carrying out the tests with this rotary-kiln type of furnace.

We employed the Cottrell apparatus for precipitating the fume from most of these tests, but did some work with muslin bags as well. Both processes seemed more promising than any wet method of precipitation that other experimenters had employed. We finally confined our tests to the Cottrell process, which later was recommended to the Pope-Shenon company for its plant near Salmon.

The question of the reduction of the dry chloride fume to metal was early before us. The results of reducing lead chloride to metal by fusing with lime and coke had not been encouraging, although we had confirmed the chemistry of the reaction involved and had tried the operation on a small scale. Now, with the larger quantities of nearly pure chlorides of copper we found the verification of the theory easy. The first fusion test performed on 200 grammes of Cottrell fume, containing 41% copper, gave a fluid-pour and we anxiously awaited the cooling of the mold in order to satisfy ourselves that the copper was at the bottom. Our hopes were more than realized when we took from the bottom of the mold a clean bar of copper weighing 78 gm., or over 90% of the weight of the copper in the fume. The metal from this fusion contained small amounts of sulphur and iron,

FURNACE FOR VOLATILIZATION

but was about 95% pure. Other fusion tests made with more carefully calculated charges gave higher extractions and better grades of copper. The fusion with lime and coke was checked thoroughly, and this method of reduction was recommended for the pioneer plant at the Pope-Shenon mine.

The slag was found to be principally calcium chloride carrying about 2% copper along with the silica and other impurities in the fume. Slag, analyzing 50% chlorine, was found to act vigorously in chloridizing the copper in a new lot of ore. This slag was even more active than raw calcium chloride, for the moisture, which makes up 25% or more of the raw material, was absent from the slag. It was recommended therefore that the company provide for the re-use of the fusion-furnace slag as a chloridizing agent in the volatilization furnace.

The one feature that we could not determine definitely by laboratory tests was the kind and size of furnace required for the reduction of fume to metal. We had not

produced copper-chloride fume in quantity sufficient to enable us to decide this point. Upon making inquiry of the manufacturer of one type of fusion furnace as to whether we could rely upon his furnace to do the work we received the reply that if we would send him a ton of fume he would experiment and let us know whether his furnace would do our work. We did not try to prepare a ton of fume in our laboratory tests, but decided to await the erection of the volatilization unit of the plant at Salmon. We did provide a small potless tilting-furnace to use for the fusion and reduction of the fume at the plant in order that we might determine the size of furnace necessary for the work. With this tilting-furnace we melted the fume from the Cottrell treater in lots up to 500 lb. with satisfactory results. The hearth-area for a given amount of fume per day was decided upon and a reverberatory furnace was designed to treat that amount of fume.

The laboratory tests on the larger lots of ore gave satisfactory results with the rotary-kiln furnace. A similar furnace, therefore, was decided upon; in fact, the important principle was kept in mind in the design of the entire plant, that no new and untried furnace or machine should be used. We did not wish to risk mechanical difficulties when we knew we would have metallurgical innovations 'a plenty' to attend to. Standard but up-to-date machinery and apparatus were chosen, and of the wisdom of this procedure we are now convinced.

The reduction plant as completed provides modern means for preparing the ore for treatment. The bin at the mine takes the ore from the mine-cars. A man below draws the gate and the ore slides into a surface tram-car to be lowered by gravity to the mill, 500 ft. down the hillside. Cars are lowered on a double-track tramway, where they dump automatically into the bin at the mill; the full car descending brings back the empty.

From the mill-bin a Wahlin feeder provides a uniform feed to a Universal high-speed jaw-crusher. The products from crusher and grizzley go to a bucket-elevator to be raised to a Mitchell virating screen. The cloth on the screen is 10-mesh; the undersize goes to the bin for crushed ore. The oversize drops to the rolls and its product goes back to the vibrating screen in closed circuit.

An inclined belt-conveyor transfers the fine ore to a cross-belt conveyor running over the bins. This last belt-conveyor is shifted by hand to feed the fine ore to the storage-bins, of which there are three in a row, each holding a day's run of ore; a bin for salt is alongside. Ore-chutes from beneath the four bins mentioned deliver the ore and the salt. The Wahlin pulley-feeders used are quickly adjusted to feed the exact quantity desired, so that with proper adjustment for ore and for chloride the computed mixture remains the same till the ore-bin is emptied. The feeders deliver the ore and the salt to a long belt-conveyor that in turn delivers the 'mix' to a distributing box arranged just above the steel hopper provided for holding two tons of the mixed ore and salt. This hopper, with the shape of an inverted pyramid, has at its bottom a plunger-feeder above the furnace. The length and the number of strokes of this feeder determine the rate at which the mix is fed, and can be adjusted to suit conditions.

The cold ore drops through the steel chute from the plunger; it is raised by the revolving furnace until it drops back by gravity, slipping and sliding, heating as it moves slowly down the kiln. By the time the ore and the chloride are heated the mixing is thorough enough to provide the intimate contact required as a physical aid to volatilizing reactions between the salt and the metal. During the course of the ore through the furnace the volatile fume is escaping until the spent ore drops into the discharging launder freed from its copper, but granular still. Only incipient fusion commences and often the residue carries some dust. Unless too much salt in proportion to copper is added and free salt remains to make the tail pasty, a furnace sufficiently hot to ensure the volatilizing of the chlorides of copper is safely maintained without fear of fusion.

The launder that receives the spent ore carries the surplus water from a tank on the steep hillside. This tank, supplied by a spring, is also a protection against fire; 16,000 gallons of water is stored, with supply- and discharge-pipes attached underneath. The fire-line is a 2½-in. pipe, furnishing a stream that will protect the highest point of the mill structure. This provision reduces the fire-risk and the insurance rate.

The overflow-pipe from the tank on the hillside furnishes water to sluice the tailing through the discharging launder, constructed of concrete, with a slope of 1½ in. per foot. The water shoots from the pipe through a nozzle arranged to play on the stream of red-hot ore. With uniform streams of both water and tailing everything works smoothly, and the flow of the stream down the launder and over the hillside is uniform. If the furnace discharge is sintered and balled and furnishes lumps to be sprayed, regular progress is greatly impeded; and for this reason care must be taken properly to regulate the mixture and the temperature. The space available for dumping is enormous.

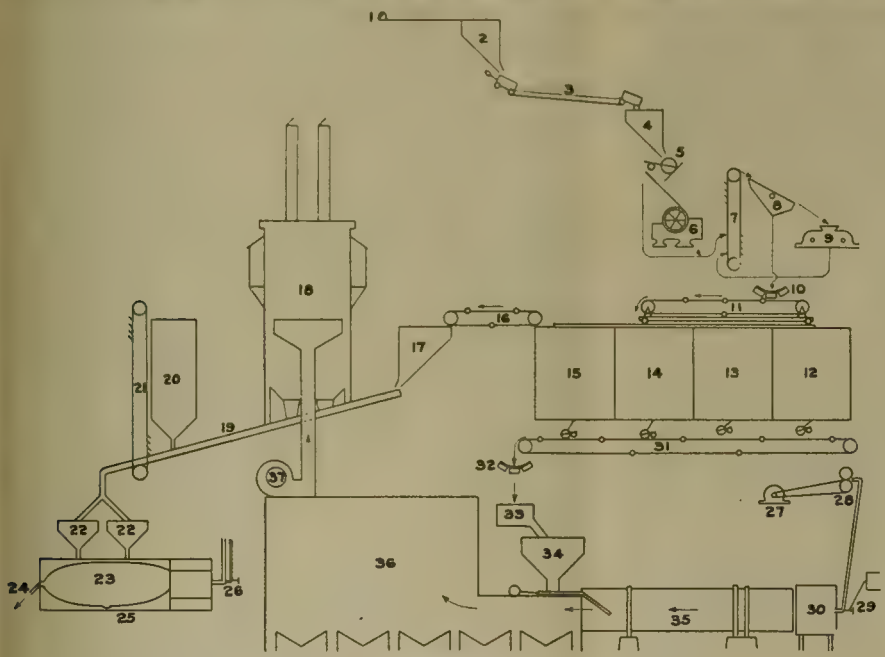
The fume from the furnace passes from the feed end into a flue for collecting; the dust is carried away mechanically from the ore-mixture by the moderately strong draught through the kiln.

The flue is made of reinforced concrete provided with hoppers to collect the dust. The coarser particles drop into the hopper next to the furnace, and in turn the smaller pieces accumulate in successive hoppers. The settling-chamber is 5 ft. by 4 ft. for the first 12 ft. of length; it is then increased in height from 4 ft. to 10 ft. The chloride fume, free from the furnace dust, goes to the Cottrell precipitator from the top and at the end of the chamber through a large fan with a slow-moving vane.

The treater is also of reinforced concrete; it has 36 pipes, each 15 ft. long and of 8-in. diameter, made of sheet-iron. These pipes are suspended from a concrete

header-floor hanging vertically through the floor at the top of the collecting-hopper, into which all the fume passes directly from the fan. The pipes extend downward through the bottom header for one-third of their length, so that the incoming fume passes between and around them. This serves to distribute the fume more uniformly to the open-mouthed pipes. Small iron wires pass down through these pipes, carefully centred from a grid at the top. Twenty-pound cast-iron weights keep the wires taut, and just above the weights another grid prevents swinging. Both of these grids and the suspended wires are carefully insulated from the ground to carry a current of 75,000 volts and provide a brush-discharge from wires to pipes. The roof of the treater is of reinforced concrete; the whole structure is accordingly fireproof. On top of the flat roof two stacks are provided, 2 ft. in diameter and 20 ft. high, made of $\frac{1}{8}$-in. steel plate closely riveted. Trap-doors, hinged at the top of these two stacks, close when the pipes below are being tapped. Below the suspended pipes hoppers provide for the accumulation of collected fume up to a limit of 85 cu. ft. Two tons of fume may collect in these hoppers before it approaches the weight too closely.

As the gases pass up through the pipes the solid particles become electrified and are deposited, forming a layer inside of the pipe and around the fine wire. Once every hour, or, at stated intervals, when the deposit builds to one inch thick, the hammers, operated by levers connected with ropes, are brought into action and the pipes are tapped. It takes but a moment to shake down the fume, but during this interval all draught is stopped and the stack-doors are closed. Since all the pipes are in a single compartment a loss of fume results when they are tapped. A duplicate unit to be built will make possible continued operation of both kilns during the tapping period by turning the dampers so as to pass all the fume through one treater. All solids will thus be reclaimed from the fume, and gas only will escape from the top of the stacks.



FLOW-SHEET OF POPE-SHENON VOLATILIZATION PLANT

1. Portal of mine-adit
2. Storage-bin
3. Gravity tram
4. Ore-bin
5. Feeder
6. Crusher
7. Bucket-elevator
8. Mitchell screen
9. Rolls
10. Inclined belt-conveyor
11. Distributing belt-conveyor
12. Ore-bin
13. Ore-bin
14. Ore-bin
15. Salt-bin
16. Belt-conveyor
17. Bins for limestone and coke
18. Cottrell precipitator
19. Screw-conveyor
20. Bin for fume
21. Bucket-elevator
22. Feed-bins
23. Reverberatory furnace
24. Slag-spout
25. Bullion-spout
26. Oil-burner
27. Motor
28. Blower
29. Oil-burner
30. Rotary kiln
31. Belt-conveyor for mixing
32. Belt-conveyor for feeding
33. Bin
34. Feed-hopper
35. Rotary kiln
36. Dust-chamber

Once every shift the accumulated fume passes through a screw-feeder and a closed bucket-elevator to a storage-bin, holding some 20 tons. The fume from this bin is fed by pulley-feeder to a conveyor that passes beneath the storage-bin holding the limestone and coke which are fed on to it. The three ingredients, thoroughly mixed, are discharged into a pair of feed-hoppers above the hearth of the reverberatory furnace.

When the mix from the hoppers is fed to the furnace the surface is melted by reflected heat from the roof before the oil flame is allowed to impinge upon it. This method prevents the escape of fume carried mechanically up through the stack. The melting-temperature of copper-chloride fume ranges from 700° to 800°C. It takes but a few minutes to heat the surface of each new addition of mixture and melt the top layer, thus forming a blanket to shield the light fluffy fume from the strong draught. As fusion proceeds, the reactions between the lime, the fume, and the coke are completed. The final products are metallic copper and slag of calcium chloride, both somewhat impure.

The grade of the copper as well as that of the slag depends on the impurities in the fume. The limestone and coke are added in quantities only sufficient to reduce the fume. The slag and the copper are handled in the usual way; the temperature is sufficiently high to avoid all danger from freezing. The slag is collected for use as a chloride to add to fresh ore for the rotary kiln. The slag should be kept in a closed bin to prevent its taking up moisture and becoming wet. It is fed in dry condi-

tion to the crushing-mill and ground each day to the same fineness as the ore and salt; it is then followed by ore through the crushing-mill, thereby making certain that all of the slag is cleaned from the launders and belts. While dry, this peculiar slag does not stick in the crushing-mill, but left as a coating it robs air of its moisture and wets the belt-conveyors, screens, and machines; it is accordingly desirable to follow it with ore.

The limestone and coke are fed to the bin at the head of the mill; they are crushed to the requisite fineness and are sent by an extended belt-conveyor to their respective storage-bins. The regular crushing machinery thus serves to reduce the ore, salt, lime, coke, and the slag.

The milling department has a capacity of 200 tons in 24 hours. The rotary kiln and the Cottrell precipitator provide a capacity of but 50 tons. The ore and the slag for a full day's furnace run are crushed in one shift in the milling department. Space has been left for an additional kiln of three times the capacity of the unit now running.

The Mineral Industry During 1920

By G. F. Loughlin

*The metal-mining industry continued far below normal during 1920, although there were some temporary improvements compared with 1919. Gold mining continued in a greatly depressed condition, and the value of the country's output decreased to less than $50,000,000. Production decreased in all Western States except Arizona, where gold is obtained partly as a by-product of copper and lead ores, the output of both of which increased in that State in 1920. Less than half the gold mines of the country were active, and some large mines were closed permanently. Placer mining also was curtailed, not only because of excessive cost of operation, but because of shortage of water and hydro-electric power in California and Oregon and of local mishaps in certain other States. The small domestic production of platinum and allied metals, largely a by-product of placer gold mining, increased; the total production of refined platinum decreased. Other metals in the group showed small to moderat increases.

The production of silver was favored during the first five months o fthe year by a strong foreign demand and high prices, and, later, by the Pittman Act, which guaranteed a price of nearly $1 per ounce to producers of new domestic silver after the price of silver from other sources had declined to pre-war levels. The output about equaled that of 1919, although the value declined 10%, owing to a drop of 10.5c. per ounce in the average price for the year. Miners of silver ore were especially favored, and a few mines that had been idle since the demonetization of silver were re-opened. The price of silver also aided in maintaining the production of ores of lead until late in the year, when the prices of all these metals declined to extremely low levels. Up to the end of 1920 the Government had purchased about 30,000,000 of the 208,000,000 oz. authorized by the Pittman Act. Total purchases up to May 27, 1921, amounted to 56,283,697 ounces.

The total production of copper decreased in 1920, although production in two of the leading Western States increased. Disposal of surplus stocks by some smelters early in the year and premature expectation of revived foreign trade encouraged large production. The apparent domestic consumption increased slightly, but less than had been expected, whereas the large total stocks decreased by only 30,000,000 lb., and foreign markets were still oversupplied with new and old copper. The resulting poor demand, especially during the latter half of the year, together with labor troubles, high operating costs, and the low rates of foreign exchange, caused a great curtailment of production during the last three months of the year. There was no immediate hope of recovery in the demand for copper, and by May 1921 most of the mines had been closed. The average price of copper for 1920 was about the same as for 1919, but by the end of 1920 quoted prices had reached pre-war levels.

Lead increased in output in 1920, but did not equal the output of 1918. The recoverable zinc content of ores mined in 1920 was also greater than that in 1919, though less than that in 1918. The smelter production of primary zinc from domestic ores, however, was a little less in 1920 than in 1919. Both lead and zinc were favored by higher average prices in 1920 than in 1919, but their prices declined rapidly toward the end of the year, when imports, favored by the low rates of foreign exchange, increased considerably. The low prices of lead and zinc at the end of 1920 caused great curtailment in production, and the output during the first four months of 1921 has probably been 50% of normal.

The increased demand for iron and steel during the first half of 1920 cause a corresponding demand for manganese, and both domestic production and imports increased markedly. Continued high prices and depleted reserves favored those best equipped to produce domestic manganese. In contrast to manganese, tungsten was in little demand, and domestic production was the smallest since 1920; nevertheless imports were large for peace times, in anticipation of a heavy duty. The production of domestic chromite, also affected by large stocks and by inability to compete with imports under normal conditions, underwent a further decrease. Only one molybdenum mine was operated during the year. The production of nickel in Canada underwent fluctuations similar to those in copper and iron. The production of titanium ore (rutile) more than doubled in quantity, and uranium and vanadium minerals, used to some extent in the steel industry but chiefly valuable because of their radium content, more than doubled in value. The production of buaxite for all uses increased nearly 40% in quantity and nearly 50% in value, and the value of aluminum manufactured also increased. Imports of aluminum also made a large increase. Continued growth of the aluminum industry in 1921, or as soon as industry revives, is expected.

*Abstracted from a U. S. Geological Survey bulletin.

Management of Mexican Labor

By Alonzo Crittenden

The general principles of human nature are about the same in every country and among all races, but native instincts should be taken into account in dealing with different nationalities. Successful management must be based on the principles of justice; but in order to do real justice, one must have the qualities of judgment, courage, experience, as well as an intelligent knowledge of conditions. Mexican servants have been called the best and the worst in the world, and the same may be said of Mexican unskilled labor.

Colonel Kosterlitsky, the chief of the northern *rurales* of Mexico, was sitting in a *café* at Cananea. It was evening. An American friend had just asked him his opinion of the Mexican as a soldier. At that moment, the motor train from the smelter had dumped a load of liquid slag, and its fiery glow had lit up the surrounding landscape for a brief moment; then it faded into inky blackness. The Colonel pointed to the fiery molten mass: "You can lead the Mexicans through that," he said, "but they have no initiative—they can do nothing alone." This remark may be said to epitomize the handling of Mexican labor.

To understand the Mexican workman—and without understanding there can be no real success in directing him—one must go back to his racial origin. Half the population of Mexico is pure Indian. Of the remainder, about three-fifths is of mixed Spanish and Indian blood; and the rest Spanish, or other white stock, mostly Spanish. Those of Spanish descent are generally the dominant element, though there are numerous exceptions. Many of mixed blood hold influential positions; some of the great leaders have been Indian. Juarez was of pure Indian blood and Porfirio Diaz himself was one-quarter Indian. But the mass of the people, and nearly all the laboring class, show general Indian characteristics. Personal leadership is the main thing with them. They are guided by men, not issues.

Great things have been accomplished with this labor by those who understand and can direct it. Napoleon's maxim that an army of sheep led by a lion is better than an army of lions led by a sheep, although, like all epigrams, not embracing the whole truth, holds good. The Mexican workman intellectually is a child. He is governed by emotion rather than by reason. He does not bother to think about what does not immediately affect him. As a rule he is not hard to please and to satisfy; indeed, he is somewhat of a philosopher in a superficial way. He even has a strong feeling of loyalty to a boss who appeals to him as being the real thing, that is, whom he can respect and look up to. Such a one may be a hard boss, if he is a just one; mere driving and brutality, however, will not get one very far.

A Mexican, unlike a white workman, does not fear being discharged. The idea of holding his job, and dreading the loss of it, will often cause a white man to accept much injustice, to work under unhealthy conditions and with excessive exertion for a considerable time; he wants to make good; he values public opinion and looks to the future. These motives do not act, to the same extent, as an incentive to the Mexican; frequently, they are unknown to him. One might say that there is no public opinion in Mexico; the Mexican workman does not think far enough ahead to bother about the future, and so he is mostly guided by his present emotions. Also, his personal likes and dislikes are strong; he readily responds to personal leadership, without thinking of the principles involved. It is inconceivable that he would fight through a war for a principle—an idea—as the American colonists did when they fought against taxation without representation. Yet he will fight well under the right kind of leadership. Some Mexicans who went to France in the Great War made good records.

Owing to the low intelligence, culture, and education of the laboring classes, caste lines are drawn strictly in Mexico; under existing conditions it is necessary to observe them if one is to be successful in directing and controlling Mexican labor. The Mexican workman will misunderstand an attitude of social equality toward him, and one adopting that attitude will be held in contempt; he cannot be your equal; he must either be your superior or your inferior. Treat him justly and kindly, but never with familiarity, for if you do you will not only lose his respect, but you will spoil him as a workman. He will regard this treatment as an evidence of weakness and fear, and will endeavor to become your master. In his eyes your attitude will be a confession of weakness and inferiority.

Many Americans, with the best of motives and the worst of judgment, have made this mistake and suffered for it. Many American mining men have been murdered by their *mozos* in the lonely mountains of the Sierra Madre. Yet many more have penetrated to the most wild and desolate parts of that region, alone, with ordinary Mexican *mozos* and with perfect security. I spent a year and a half in the most inaccessible parts of the Sierra Madre with Mexican and Indian *mozos*, and was treated with the utmost loyalty and respect.

One who travels much in Mexico will often hear the phrase, "It is the custom here", when he objects. They seem to think that it is an entirely sufficient reason to give in answer to any kick. I had often received this answer myself, and so, on the theory that "what was sauce for the goose, was sauce for the gander", I thought that I would try it on them when they objected to any of my rules or methods, although I must say, without a

great deal of confidence. However, it worked like a charm; the magic words seemed to satisfy completely my Mexican employees, and they would go off contented. It has been said of the Mexicans that a smile and a cigarette will go further with them than a substantial raise in wages, if accompanied with sourness. This is more or less true of any people. A smiling face and a pleasant manner are business assets.

The Mexicans are human, and, in common with all races, appreciate just treatment, although at the time they may not seem to show it. They resent injustice although they may not know how to remove the grievance and secure redress. In showing this resentment they often do not take the direct and straightforward course of protesting to their boss, or *patron,* against the injustice, and giving their reasons. They fail to adopt this obvious and manly way of endeavoring to secure redress, perhaps through timidity and fear of being placed at a disadvantage; but they will go the more crooked route of waiting for a favorable opportunity to strike on some mere pretext, which would not have been taken seriously by them had not the seeds of discontent and rancor been sown by continued acts of injustice.

At a mine in Sinaloa, the American superintendent had a system of petty impositions, which he practised on the men, and actually thought that he was serving his employers, the company, thereby. The traditional duration for work in the mine was ten hours per day, but he not only exacted the full time under the unwholesome and arduous conditions of modern mining, but even increased the actual time of their labor in different ways, by making them carry their tools a considerable distance on their own time. He also adopted a hard and unsympathetic attitude in all his relations toward them. This was an extremely unwise policy; before long the morale of the camp was spoiled; the men became indifferent, dissatisfied, and resentful; they showed their ill feeling in a number of ways. The superintendent was always having petty strikes to settle, and the working efficiency was low. The assistant superintendent was in charge when the superintendent was away on the company's business; and, adopting a more just and humane attitude toward the men, he was shown greater respect and exercised a greater control over the Mexicans. More work was done and a higher efficiency resulted. He also had a contented force. The Mexicans showed in many ways their resentment of the treatment accorded them in the one case, and their appreciation of their treatment in the other case. They favored the superintendent with a passive resistance and obstinacy that developed at times into active hostility; they would do nothing for him unless they were paid for it. If a crowd of Mexicans was close to where he dismounted, none would step forward to hold his horse. For the assistant, however, they rendered eager and willing service, and accorded him the respect and consideration that the Mexican workman is pleased to give if he thinks his master is worthy of it. This is something that money cannot buy. Money and authority can enforce an outward and superficial obedience, but there are things that neither authority nor force can compel, even from a Mexican laborer, though they are freely rendered to one who possesses higher traits of character. They were rendered to the assistant at this particular mine. If there were any Mexicans standing about where he dismounted, one or more instantly stepped forward to hold his horse; in many other small ways they showed their appreciation.

One of the most serious problems in that country is to keep *tequila* and *mezcal* (the native whiskey) away from the Mexican workmen; for when they are full of *mezcal* they are difficult to control. One day the superintendent and his assistants were working in the office. In a nearby shanty a crowd of Mexicans, men and women, were holding a celebration. It was immediately after pay-day and they had a brass band. They had smuggled plenty of *mezcal* and were having a hilarious time, much to the discomfort of those who had been on night-shift and were trying to sleep, and also to two officers of the company who were trying to work in the office. Situations such as this should be avoided by taking proper precautions, but if they do occur they should be handled with great discretion. In this case the 'super' lost his head. Aggravated beyond endurance he buckled on his pistol and remarked that he was going out to stop the nuisance. The assistant was unarmed but said he would go with him, so they both walked over to the scene of festivity. The 'super' ordered that the proceedings stop instantly, and told the musicians to leave the camp. A tall miner instantly stepped forward and told him that it was none of his business. One word led to another; the miner, who was too full of *mezcal* to be afraid of a gun, drew a knife and started for the Americans. The 'super' drew his gun and covered him. The other Mexicans were uncertain as to whom to follow. It was then that the assistant, who had hitherto been a silent witness of the scene, stepped forward and said sharply to the bystanders, "That man is drunk and will get himself into trouble. Seize him and hold him." The Mexicans, who respected him personally and were accustomed to obey his orders, leaped on the belligerent miner and pinned his arms. The assistant having thus assumed the leadership spoke a few words to the musicians in a cool and matter-of-fact way, and told them to disperse; the incident was closed.

In another case the company was driving a drift at the low cost of $3.90 per foot in fairly hard rock. The Americans in charge pointed the holes and paid the Mexican miners so much per foot for doing the drilling—a system of piece-work. The miners were continually asking for a contract; they were making more than the usual wages by piece-work under the direction of the American boss, but they thought they could do better. At first they wanted $10 per foot, but on being told that it was actually costing the company less than $4, they finally consented to take the contract at $4 per foot. Without the necessary supervision in pointing the holes, they soon began to run behind; they commenced to quarrel among themselves and made little progress. At the end of two

weeks they were in debt to the store, and were willing to give up their contract and go back to wages or piecework. They had to have someone to do their thinking for them; they could do the work, but they could not plan it.

Good results have been accomplished with Mexican labor, and also dismal failures. The Anglo-Saxon laborer will maintain his standard of work under poor leadership, but the Mexican rapidly deteriorates. Real leadership implies a superiority—superiority in patience, knowledge, courtesy, tact, refinement, force, and courage. Character is the grandest thing, it is the basis of all achievement. Different types of men are successful in controlling Mexican labor, but whatever the type, it must be genuine. Any false note will have a bad effect on discipline. They respect the quiet and refined type of superior who has the air and manner of a gentleman and who possesses a confident way of directing them.

The boss should realize that his position is assured and that nothing that the Mexicans can do can affect him in the least. This will produce an attitude the reverse of arrogant, which generally springs from a lack of true worth and which it seeks to hide by a vulgar display of bluster. The supremacy of this type of boss is more marked than in the case of the mere driver, because his influence is a moral rather than a physical one. The mere driver, who rules only by force, may accomplish results with Mexican labor, but his success is not nearly so great or enduring. Firmness is necessary, but brutality defeats its own end. It has often been said that Diaz ruled Mexico with an iron hand, but that there was a great deal more to his rule than force alone. He was *simpatico*; this word has no equivalent in English; its use infers the highest praise that a Mexican can bestow to express liking and respect. It refers to one who is amiable and sympathetic in his personality and whose attitude is not inconsistent with an iron firmness when the need arises.

In dealing with Mexicans, it is as well to call their attention to every dereliction of duty; but not to censure them severely or to "bawl them out". The idea is to let them know that they are not 'getting by' or imposing on you. One should be perfectly calm and good-natured about it, yet serious. The employer of labor in an isolated camp must often be a judge, police officer, and general referee, as well as the director of operations. He should understand the Mexican's point of view and have the ability to sense the state of mind of his workers.

For a boss that they like and respect, the Mexicans have a great deal of loyalty. Some are steady workers, but many will slacken after a while and need to be discharged. A Mexican does not mind being discharged; he does not look upon it as an ingnominy or a disgrace, as a white man does. If he gets too lazy and indifferent about his work, or especially if he gets to be a sore-head and complains or 'knocks' to the other men, it is best to discharge him at once—the sooner the better—as his example will have a bad effect on the rest of the men. But this discharge need not be permanent. His malady is generally acute, not chronic, and he will be cured in a little while. When he comes back and asks for work, as he almost invariably will, he should be re-engaged, and will probably make a good worker.

ANTIMONY is found over widely scattered areas in the central and southern Provinces of China, according to the U. S. Geological Survey, but principally in Hunan, Yunnan, Kweichow, and Kwangsi. The deposits have been developed for the last two decades. Those in Hunan have been most extensively exploited, probably 90% of the total production of China coming from the region about Changsha, the centre of the smelting industry. The most productive district in Hunan is Kai-keng-shan (Shikung-shan), in the valley of Tzu river, about 12 miles east of the Hsinhau. In 1915 about 70 companies mined antimony along the outcrop of the deposits in this district. The ore, which is mainly stibnite of remarkable purity, occurs as pockets and bunches in a flat bed of dolomitic limestone. Mining is carried on in a crude fashion by natives. Several local smelters produce liquated sulphide, and the output of the district in 1915 was about 1000 tons monthly of crude ore averaging about 70% metallic antimony. All regulus manufacture is controlled by the Wah Chang Co. The Panshi district, which produces considerably less, is 25 miles from Chanshi, on Tzu river, in a very mountainous region. The ore in this district occurs in a series of veins in upturned slates, shales, and quartzites. The output of the district in 1915 consisted of about 400 tons monthly of 30% ore, all of which was shipped to the Wah Chang Co., at Changsha, for treatment. Other producing districts in Hunan are the Wa-shi district, east of Shenchowfu; the Hua-pan-hsi district, in Anhwa; and the Chiang-hsi-lung district, in Chupu-hsien. The only district in Yunnan where antimony is handled commercially is near Chihtsun, on the Tongking-Yunnan railroad above Mengtse. The Pao Hua Co., connected with the Wah Chang Co., owns a French-constructed plant here and produces high-grade regulus. During the period of war-time high prices some antimony was smelted and refined at various points in the Provinces of Kwangtung and Kwangsi, but the smelters in these Provinces have now closed and the production has ceased. The Wah Chang Mining & Smelting Co. largely controls the production of antimony ore, regulus, and crude in the Province of Hunan. This company operates smelters in Changsha and owns certain mines of low-grade ore. It possesses a complete monopoly, granted by the Peking government, for the manufacture of regulus in Hunan, and owns the patent rights in China for the Herrenschmidt furnace, the most successful means of reducing low-grade antimony ores. Most of the mines themselves are owned by natives and operated in a small way. In recent years there has been a tendency to smelt the ore at the mines, a procedure which promises to lower the cost of production. Adverse exchange conditions, due to the high price of silver, have nearly doubled the cost of production in China. Wages also have advanced in that country.

Fatigue, and Atmospheric Conditions in Mines

*Recent investigators have discussed the question of the health of underground workers, and have emphasized the necessity for conditions that will not lower the efficiency of the defensive mechanism of the human frame against disease. Although not directly conducive to specific diseases, such as miners' phthisis or tuberculosis, such conditions may result in a feebler resistance against them, and should therefore be avoided. In recent years there have been two remarkable changes in the opinion of competent authorities on the question of the relation of atmospheric conditions in mines to health. About twenty years ago it was thought that carbon dioxide was in itself a poisonous constituent in mine gases, and that the amount present should be kept below 1%. When the Transvaal Mining Regulations Commission of 1908 made its report, there was a change in this opinion; the Commission reported in favor of the present South African legal standard of 0.20% because it was considered that the amount of dioxide present was a rough indication of the amount of monoxide present; by reducing the former, the amount of the poisonous monoxide would be kept within safe limits. Within recent years further research has shown that much larger amounts than 0.20% of carbon dioxide are not injurious to the human system. I would, however, deprecate the advocacy of a ventilation system that would result in an atmosphere which has already been largely affected by the respiration of other persons, even although it might be otherwise unobjectionable in its freedom from dust or traces of irritant and poisonous gases. Although, according to Leonard Hill, an atmosphere containing large quantities of carbon dioxide, and heavily contaminated with the expired air of other persons, had no ill effects on students, it should be pointed out that an experiment of this character only shows the result of inhaling such air for a short period. If the test had been continued for a year the result might have been different. Coal miners in Great Britain and elsewhere enjoy good health, although the amount of carbon dioxide in the air they breathe is, in many cases, high. But the coal miner has the benefit of breathing air that has suffered little, if any, contamination from the breath of other persons. I see a source of danger in the suggestion that, so long as the air is moving, it does not matter much whether it contains 0.2 or, say, 1% of carbon dioxide. By all means keep the air moving, whatever its quality, but let us do our best at the same time to see that it is fresh.

There is, moreover, an added danger in using air over and over again—merely circulating it to give more comfort and to cause less fatigue to the worker. During such circulation the coarser particles of the dust, which such air may have picked up elsewhere, are eliminated, mostly by settlement on adjacent surfaces; but the finer dust may go on accumulating. This fine dust is invisible, and no suspicion may arise that the air is not good. In one of the Geduld shafts some years ago it was found that, owing to a leakage in the pipes, a fan was circulating the air over and over again. This air was perfectly clear, but was found to show fine dust of about one micron diameter in numbers of 1000 and upward per cubic centimetre.

The other question on which medical opinion has lately undergone considerable change is the effect of high temperature and humidity on health. Only a few years ago it was generally considered that, although a wet-bulb temperature of 83°F. or over might greatly diminish a laborer's output of work, it had no detrimental effect on his health. Some of us had a suspicion that this was doubtful, but we did not venture to dispute it. Experiments with air in motion, and, more recently, statistics obtained from the use of the katathermometer, have thrown new light on the subject; the conclusion that conditions which induce undue fatigue when performing work must be detrimental to health is realized to be logical.

In the Final Report of the Miners' Phthisis Prevention Committee may be found statistics relating to death-rate and temperature, and referring to the year 1915-1916.

Underground Air Temperature (Dry Bulb) and Death-Rate in Rand Mines

Range of temperature	Number of mines in each temperature group	Total death rate in mines of each group	Pneumonia death rate	Total death rate excluding pneumonia
66°–68°F.	2	13.1	5.1	8.0
69°–71°F.	14	15.7	6.9	8.8
72°–74°F.	20	16.4	7.6	8.8
75°–77°F	9	17.9	6.5	11.4
78°–80°F.	8	20.5	8.5	12.0

The Committee was in doubt whether the higher death-rate in the hotter mines, as shown in this table, was due entirely or mainly to the higher temperature, and comments as follows: "It may be pointed out that the hotter mines are also the deeper, and that the air in these mines differs from that of the shallower mines in other respects than temperature, as, for example, in barometric pressure. This may also affect the death-rate."

The higher temperature may be the main cause of the higher death-rate, in that it lessens, in various ways, the resistance of the body against disease. Further experimental work is needed to show the relative outputs at high temperature under varying conditions in respect of Kata readings and humidity. There is no doubt that if the conditions at higher temperatures can be ameliorated by ventilation and other means, the laborer will be able to show a fair output of work; but I am tempted to think that an additional but probably more effective method of increasing his working capacity is to employ him as little as possible on classes of labor that need a large output of energy. Substitute for the muscle of the laborer the energy of the compressor and the dynamo, directed by the brain of the worker, but involving as little muscular labor as possible, and it will probably be found that improved economy of exploitation and better health for the workman will result.

*A contribution, by Sir Robert Kotzé, to the discussion of a paper on the subject in a recent issue of the 'Journal' of the South African Institution of Engineers.

THE WORLD'S ZINC INDUSTRY

The condition of the English zinc industry, according to the American Zinc Institute, is without change; British smelters cannot produce zinc at present market price. In the past it has been customary for all virgin zinc to be classified as g.o.b. (good ordinary brands), with the result that metal of 99% purity failed to command the premium to which it was entitled, except from those consumers who had found it necessary to restrict their dealings to certain brands which possessed characteristics suitable for the purposes intended. Thus the roller of sheets was satisfied to pay a premium varying from 2s.6d. to 10s. per ton for slab zinc containing a minimum of cadmium. There is no reason why the grades of higher purity zinc should not carry the same 'spread' as in America. In view of the fact that all the zinc which the British Board of Trade will receive under its long-term purchase agreement with Australia will be of a purity of 99.95%, one would think that they would enter upon an educative campaign agong all consumers in the country for the purpose of satisfying various users that in many cases it is economical to pay premiums for specific qualities.

In France the zinc industry is not prospering, and there is no object in output being increased even at the re-built smelters at Montagne-du-Nord. In any case, France is never likely to aim at a production in excess of her own domestic requirements.

The Federation of Zinc Smelters in Belgium is maintaining its production at about 4500 tons per month, and a welcome revival in Continental consumption has prevented any marked augmentation of stocks. Slab zinc on hand in Belgium amounts to about 11,000 tons, but stocks of rolled-zinc sheets still remain at over 40,000 tons, mainly the property of the Vieille Montagne. The demand for ore is exceedingly light, for the reason that the Belgian smelters have sufficient calamine and blende on hand to carry them along until February 1922 at the present rate of zinc production. The smelters have still to take delivery of a considerable quantity of Australian concentrates under contract, and the treatment of these at the price paid represents a substantial loss at the current market price of the metal. Today, under existing circumstances, Belgium can hardly afford to pay more than £4 15s. per ton for Broken Hill concentrate of the standard grade of 47% zinc, 6% lead, and 10 oz. silver.

Notwithstanding the obscurity of the German zinc situation, two factors stand out clearly: (1) the current production is very light, and (2) the unsold stocks are not excessive. The total production today does not exceed 4000 tons per month, as smelting in Silesia is paralyzed, pending a definite decision on the fate of Upper Silesia. The Inter-Allied Commission has found that the settlement of this question bristles with difficulties. Zinc, in common with all manufactured goods in the disputed area, is to all intents and purposes immobilized for the time being. Owners of merchandise there can only offer on the promise of delivery when transportation from Upper Silesia is resumed. In Germany the consumption of zinc is small and the low production is sufficient to take care of it. The unsold stocks of virgin zinc in the country are computed to be 16,000 tons, and the holders show no desire to offer this on the London market; indeed, the German government has hinted to the owners that the export of this comparatively small stock of zinc is undesirable. The British government has reduced the tax under the Reparations Act on German goods entering the United Kingdom from 50% to 26%, but in order to remove this disability to German exporters the German government has agreed to bear such burden itself. The modus operandi is for the German seller to accept payment of 74% of his invoice, the British buyer paying the remaining 26% to the British Customs as tax. Against the production of this British official receipt for 26% of each invoice the German seller is entitled to recover promptly from the German government the equivalent amount in marks at the exchange of the day on which payment of the 74% was made. Were Germany, however, a seller of zinc today, there is nothing to prevent her selling to a neutral country for re-sale to Great Britain, as German zinc so dealt in escapes the terms of the Reparation Act. This is a fact known to few, if any, of the English importers of continental metals.

In both Norway and Sweden the zinc smelters are operating at low capacity, which may be easily understood when it is explained that the producing cost at the hydrothermic works are certainly not less than the Belgium distillation works' cost today of £30. While Scandinavia outputs some 98.5% zinc, the main quantity runs from 99% to 99.9%. Generally speaking, European trade has been in such a condition during the past nine months that zinc of higher purity than prime Western has been difficult to place, except in small quantities; hence, it has been no uncommon occurrence for the Norwegian and Swedish sellers of late to deliver 99% purity metal against g.o.b. sales on the London market.

Both the distillation works in South Australia and the hydro-electrolytic works in Tasmania remain closed and operations are confined to the erection of further units at the latter point. The shipment of small parcels of zinc and zinc sheets from Europe to Australia during the past few weeks is recorded.

It is a source of satisfaction to other producing countries that the American zinc smelters are wisely limiting their output to the monthly consumption of 18,000 tons. With unsold stocks equal to five months' consumption at present rate, there should be no anxiety to lift production until a better trade demand develops.

INTERNATIONAL NICKEL

Instead of waiting for business to improve, International Nickel has devised a new method which is expected eventually to be a good revenue producer, states the 'Boston Financial News'. A new rolling-mill is being erected by the company to fabricate nickel, and it is hoped to have this in operation before the end of this year. The plight of the industry, however, is vividly portrayed in the quarterly statement of the company for the first quarter of its fiscal year ended June 30 last, profits after preferred dividends amounting to but two cents per share on the common stock. Small as the result is, however, it does not come as any

surprise to those who follow the industry. As a matter of fact, it was expected that the first quarter of the company's year would show a deficit after preferred dividends, so that the two cents per share on the junior issue may be considered satisfactory in view of the present situation. One of the very prominent reasons for the company showing a slight profit was due to the fact that early in March a reduction in wages amounting to 15% was put into effect. In addition, rigid economy in all departments helped in making it possible for the small quarterly profit of approximately $46,000. Despite the poor start on the current year, the outlook is not so black as in other lines. One of the first industries to feel the effect of the readjustment, International Nickel is about ready to start forward again. Nickel stocks in consumers' hands are reported to be down to a minimum amount, and although the demand is still small a steady improvement is going on. While junior stockholders are not receiving any dividends, there is some consolation in the fact that the company is not losing money. In the year ended March 31, 1921, the company carried to surplus $1,494,000, equivalent to 89c. per share on the outstanding common stock of $25 par value. Although the resumption of dividends is still problematical, when normal conditions develop the company should be in a position to resume.

SILVER AND GOLD PRODUCTION IN MEXICO

The following tables, from official sources, gives data as to the silver and gold produced in Mexico for the first six months of 1920 and 1921, respectively.

Production of Silver

	1920 Oz.	1921 Oz.
January	5,301,599	7,206,060
February	5,646,591	5,661,358
March	5,891,070	3,815,176
April	5,081,275	4,846,741
May	5,337,414	3,894,841
June	5,851,718	5,075,328
Total	33,112,667	30,499,504

Production of Gold

	1920 Oz.	1921 Oz.
January	60,667	69,380
February	64,846	57,709
March	64,975	51,597
April	60,543	45,235
May	65,041	54,761
June	73,913	41,797
Total	379,985	320,579

Value of Silver and Gold Produced, Six Months Period

	1920	1921
Silver	₱77,483,701	₱42,599,405
Gold	15,980,170	13,463,898
Total	₱93,463,871	₱66,063,303

It is stated that the Mexican government is at present buying all the silver presented, paying either in gold coin or with sight drafts against New York, at New York quotation. All silver delivered to the Government is free of export tax. The sale of Mexican silver in the City of Mexico, therefore, results in less expense to the seller, as it costs less to deliver it there than to deliver it in New York. This open market for silver should have a good effect on the industry, as most of the silver produced in Mexico is thus removed from New York and London markets.

JULY COPPER SALES

July sales of copper, both foreign and domestic, totaled about 75,000,000 lb. This is about 35,000,000 lb. larger than many important sellers believed the total would be. July production of primary copper for American refining was about 45,000,000 lb. During the last week of the month about 45,000,000 lb. of copper was sold, mostly at prices between 12⅛ and 12c. per pound, delivered. Recently one wire company is reported to have purchased 1,000,000 lb. at 11⅞c. Domestic and foreign sales are small at present, with buyers awaiting further indications of price trend.

GEORGE GRAHAM RICE AND THE BLUE SKY LAWS OF CALIFORNIA

In response to a request for a statement in reply to a telegram from the Utah Securities Commissioner, indicating that he has appealed to the U. S. Attorney-General to take action against the California Commissioner for violating the Sherman Anti-Trust Act, in endeavoring to prevent the sale of Bingham Galena mining stock in California until the company shall obtain a permit from the California Commissioner so to do, Commissioner of Corporations E. C. Bellows has issued the following statement:

If there was any probability that action, as requested, would ever be taken, I should defer discussion until a judicial finding had been rendered; but feeling certain that newspaper publicity is all that is being sought, silence on my part might cause Californian investors to be misled, to their financial injury. This department has never questioned the authority and the right of the Utah Commissioner to issue permits, or to supervise the sale of securities in his own State; but when he diverts his talents to the supervision of the stock sales in California he is acting outside of his jurisdiction. He has full power to refuse the sale in Utah of stock authorized in California or any other State, provided such sales violate the Act he is administering; but to contend that securities he has legally authorized in Utah can be sold in other States, in straight violation of their Blue Sky laws, is to hold that every Blue Sky law is null and void with respect to supervising the sale of issues from Utah, a position too puerile and foolish for serious consideration.

The Corporate Securities Act of California provides that: "No person, partnership, association, or corporation, other than a broker holding a broker's certificate, then in effect, shall issue, circulate, or publish any advertisement, pamphlet, prospectus or circular concerning any security, to be issued by any company, that such person, partnership, association or corporation desires to sell, until the company proposing to issue such security shall have first secured from the commissioner a permit authorizing it to issue or sell such security." (Section 7.) Section 2 of this Act defines the word "company" as including both domestic and foreign organizations, and Section 5 makes it unlawful for a broker to operate within this State until he shall have applied for and received a certificate from the Commissioner of Corporations authorizing him to do so.

Neither the Bingham Galena Co., whose stock was offered for sale by circular to many working people in California, nor Child, Barclay & Co., the brokers who sent out the circulars, nor George Graham Rice, the promoter, has received the required authorization to operate in California. They, therefore, have incurred the penalties prescribed in Section 14 of the Act, which provides that anyone who "wilfully violates or fails to comply with any of the provisions of this Act . . . is guilty of a public offence and shall be punished by imprisonment * * * not exceeding five years * * * or by a fine not exceeding five thousand dollars, or by both such fine and imprisonment".

Being charged with the duty of administering and en-

forcing this law, and having evidence of its violation, I deemed it my duty to bring the matter to the attention of the district-attorney of the county in which many recipients of the unlawful circulars resided. This constitutes what the Utah Commissioner is pleased to term, "conspiracy in restraint of inter-state commerce". He does not seem to recognize the right of California to supervise the sale of securities within her own borders, but apparently deems a demand for compliance with our statutes a reflection on his acts, and a discrediting of securities issued in his State.

COPPER AND BRASS RESEARCH ASSOCIATION

R. L. Agassiz, president of the Calumet & Hecla Mining Co., has announced the formation of the Copper and Brass Research Association, an incorporated organization of the copper, brass, and copper-alloy interests. The purpose of the organization is to stimulate the use of those metals. Membership in the association is open to producers of copper sold here or selling-agents of copper in the United States; to fabricators of copper, brass, and copper products generally in the United States and Dominion of Canada, and to others directly engaged in or connected with the copper and brass industries.

The officers of the association are R. L. Agassiz, president; Fred S. Chase and C. F. Kelley, vice-presidents; Stephen Burch, treasurer; W. S. Eckert, secretary. William A. Willis has been appointed manager of the association, which has offices at 25 Broadway.

A. S. & R. LOSSES

The American Smelting & Refining Co., with principal offices in Omaha, lost $1,000,000 last year because of the business depression, according to claims made in an appeal from assessment of the board of equalization filed in the district court there. The company asks that valuation of its personal property be restored to $1,200,430, the valuation made in its own report on April 1, 1920, instead of $2,129,600, arbitrarily set by the equalization board as a fair valuation.

ALASKA

Hyder.—The Fish Creek Mining Co. is doing substantial development on its claims, situated in the Solman River district about a mile from the Hyder-Premier road. A promising vein of ore is reported to have been uncovered through the blasting necessitated in laying the foundations for one of the towers of the Premier mine's aerial tramway.

CALIFORNIA

Jackson.—Within a month the Kennedy mine will resume its position among the gold producers of California. Retimbering of the shaft has been completed, lower workings have been repaired, and preparations have been made for resumption of mining on the 3700-ft. and deeper levels. The Kennedy has been idle for about three years, the result of labor shortage, high operating costs, and damages to the mine by fire and water.

Oroville.—A discovery of rich gold-silver ore near Yankee Hill, in the vicinity of Lost lake, is reported by B. F. Clark and John Wells. The ore has been exposed in two places and appears to be an extensive deposit. The discoverers are making plans for comprehensive prospecting.

Two veins of gold ore have been uncovered in the Wyandotte mine near Oroville. The manager states the quartz was picked up within 2 in. of the old tunnel, which failed to reach the veins several years ago. A mill surface plant and other equipment have been erected and arrangements made to send the 120-ft. shaft to a depth of 300 ft. The Wyandotte is controlled by J. A. Coutts of San Francisco.

Randsburg.—California Rand Silver reports progress for the week ending August 8: main shaft drifts 150 ft., crosscuts 25, raises 35, 11th level, L pocket, 29; a total of 194 ft.; No. 2 shaft 24 ft., pocket, 12; water shaft at Indian wells 16 ft.; total for all 246 ft. Three cars of timbers and machinery have arrived for the 100-ton mill, also the first car of steel for the water-tanks. The company intends to erect a new duplex two-stage 1300-ft. air-compressor. The payroll is 101. Grady lease, on California Rands ground, is sending 12 cars per week to the smelter. Mr. Alderson states that they are now finishing the cutting of the station at 500 ft.; this will be the principal level, with blower, motor, and telephone.——Bisbee and Brey, lessees on the Osdick claim, are now down 400 ft. and will cut a station at that level. On the third level they are drifting west.——On the Silver Reef group, the International diamond-drill company, of San Francisco, has the contract from Flynn and Elkins, Eastern mining capitalists, to sink a series of holes.

Edward Grady, of the Grady lease, has bonded the Sunset and Utopia group of 10 claims, south of the silver mines.——With a heavier engine, head-frame, and hoist, the Silver Moon lease will resume sinking from the 100-ft. level.——Julius Schede is sinking all the way on fair milling ore, in the Silver Bar lease.——Errecart and Lombard have their Ingersoll-Rand compressor on the K. C. N. lease and have resumed sinking. J. W. Hicks, in the adjoining block, is drifting north-east at 180 in good looking silver ore.——In the gold end of the Rand district, Mr. Nicolson, of the Yellow Aster, has added 5 stamps to the mill and hopes to have 30 stamps dropping continuously.——The Big Butte mill is now running on a good grade of ore from the Blackhawk.

Edward Shipsey, president of the King Solomon group, is here from Pasadena. At present the company has not decided on future developments. Mr. Hall, superintendent of the North Rand Silver, is expected home in the next few days. George Kaar is doing a lot of prospecting and development in the Gold Coin. He is likewise busy on a group of gold and silver claims situated near the Blackwater wells, 20 miles east of Randsburg.

Redding.—The Hazel Gold Mining Co. has given an option on the Gladstone mine near French Gulch to a San Francisco company, which has placed Hamilton Eddie in charge as superintendent. A small force of men has been set at work cleaning out the drifts and getting ready for active work. The Gladstone was shut-down in 1916 on account of the war prices for material and labor.

COLORADO

Cripple Creek.—July production of the Cripple Creek district as reported from the Golden Cycle, Portland, and Lincoln companies' mill totaled 39,592 tons with a gross value of $394,580.78.

The Home Run mine is again active, under lease and bond. The property will be operated by Byron Caley.——The sub-lessees of the Victor Gold Mining Co. are mining a fair grade of milling ore on the 3rd, 7th, and 9th levels and shipping about two cars weekly.——Owner Roberts, lessee of the El Paso Gold King, in Poverty gulch, is again shipping.

Idaho Springs.—The Palisade Copper Co. has resumed operations at the Wheeler mine in East Argentine, and has a force of miners developing a vein of gold-silver ore, 12 in. wide, containing $200 per ton.——The Waldorf mill is being re-modeled; flotation will be used.

Leadville.—The Cleveland, Little Winnie, Virginia, Jessie Clark, Katy, Treasure Vault, Australian, Midnight, Mosquito, 1892, Yale No. 2, Yalu, and Yamagata lode mining claims in the Leadville district, owned by the New Monarch Mining Co. were sold at sheriff's sale last week, to satisfy a judgment held by the First Trust & Savings Co., and were bought in by the plaintiff corporation at $72,396.67.

Silverton.—A new silver-lead orebody is reported to have been opened up on the Joe & John group by the Golden Consolidated Mines Company.

IDAHO

Coeur d'Alene.—In our issue of August 13 it was stated that a bond had been taken for a reported consideration of $80,000 on the Terrible Edith mine, by H. A. Morse, a mining engineer of San Francisco. This was incorrect. Mr. Morse's connection with the property is well known, but our correspondent was in error in regard to the facts of the transaction.

NEVADA

Goldfield.—The shipment made on August 3 from the Donals and Giles lease on the Florence contained 61.96 tons, containing 7.51 oz. gold and 3 oz. silver per ton, or a gross value of over $9000, according to a control assay. Another rich shipment is expected to be made in a few days. This was the second shipment since the orebody was found in the hanging wall of the old Reilly flat stope.

Simon.—Indications are that the power-line to the Simon Silver-Lead will be completed and that the plant of the company will be started on October 1.

Tonopah.—The strike that started April 16 in the Tonopah and Divide districts has been settled, the miners calling off the walk-out and returning to work on the terms of the operators, as had been foreseen practically from the beginning of the trouble. The wage reduction they have accepted amounts to 12½%. The first move to end the strike was made by the hoist engineers; their vote was followed by that of the electricians, blacksmiths, and miners.

WISCONSIN

Cuba City.—At the National Zinc Ore Separator plant, the kilns used in drying the crude zinc concentrate have been re-lined, and the Cottrell precipitators have been made ready for service. Official announcement is made of a resumption of operations on August 15. It is the intention of the National management to run steadily after the tie-up has been terminated.——The Zinc Hill Mining Co. remains shut-down. The Connecting Link Mining Co. has developed some zinc-ore deposits at mine No. 2; shipments of lead ore were made the first week in August, the price paid being on a base of $47.50 per ton, 80% metallic content.

Livingston.—Renewed hope prevails in zinc mining circles over recent developments in the zinc-lead district of Wisconsin. The Vinegar Hill Zinc Co. resumed operations at the Yewdall mine after a brief shut-down; 50 miners and mill-men are now employed. The recovery of zinc concentrate, averaging 25% zinc, amounts to 300 tons weekly. Shipments to the National Zinc Ore Separators, at Cuba City, are being made at the rate of four to six 40-ton cars weekly.——The Coker mines, No. 1-2-3, will soon resume operations. Mining machinery has been consigned to the nearest point of delivery, and the pumping stations will be rigged up for active service. Former employees believe it will require at least two months to unwater all three mines. Mules heretofore used for underground tramming will be supplanted by electrical apparatus.

Mineral Point.—The recent announcement of a reduction in the various brands of oxide by the New Jersey Zinc Co. has had the effect of stimulating business to a marked extent. Shipments of oxide are made daily in lots of considerable size; warehouses, congested some time ago, are showing the effect of lower prices. However, oxide even at the new prices is higher than before the War, and further reductions would accelerate business to the proportions usually obtaining at the big plant at Mineral Point. Two blocks of furnaces, each 12 double-compartment, force-and-down draft, are running on 24-hour schedules; mining men are encouraged in the belief that soon the Mineral Point Zinc Co. will come into the market for supplies.

UTAH

Alta.—Operations are being carried on at the Emma mine by lessees and on company account. A recent shipment averaged 35 oz. in silver and 8½% lead. Development work is being done.

Eureka.—George A. Udall has filed suit in the Third District Court at Salt Lake City against the Tintic Eastern Mining Co. to recover 200,000 shares of stock, alleged to have been wrongfully taken for assessments, and $5000, alleged to be due for services as general manager.——The Chief Consolidated Mining Co. is cutting a station at the 1600 level in the No. 2 shaft, and proposes to start a development campaign at that depth. The shaft was sunk to the water level, or 1880 ft., and is connected with the older workings by a drift.——The management of the Centennial-Eureka mine has awarded a contract for a continuation of the long drift on the 1800-ft. level.——Recent work at the Iron Blossom mine has resulted in the discovery of new orebodies above the 600 level, according to E. F. Birch, local manager of the Knight interests.

Park City.—What is believed to be the highest grade ore yet found in the Silver King Consolidated mine was discovered recently in the south-west end of the Iron drift, which extends to the right of the Spiro tunnel, about 13,400 ft. from its portal. Average assays show returns of $16 in gold, 170.8 oz. in silver, and 33.3% lead, with a small amount of antimony. On the basis of present metal quotations, this is equivalent to about $272 per ton. The Spiro tunnel is being driven forward at an average rate of 4½ to 5 ft. per day, and a second shift is to be added to hasten the work. Two headings are being driven on the 175-ft. level for prospecting purposes.——During June and July, no development work was done at the New Quincy mine. About August 1, operations were resumed. In a winze from the 900 level, near the Little Bell shaft, a streak of high-grade ore has been encountered. At present the ore is about 2 ft. in width, and averages 50 oz. in silver and 15% lead.

BRITISH COLUMBIA

Cranbrook.—The Columbia section of the A. I. M. & M. E. will hold a meeting here from August 21 to 24. Points of interest, including the Sullivan mine, will be visited.

Nelson.—At a recent meeting of Utica Mines, Ltd., the former directors and officers were re-elected. The directors considered a proposal by a syndicate that was desirous to obtain a five years lease on the mine, and was prepared to carry out development work to the value of not less than $3000 per year and to pay the company 15% royalty on all ore mined and shipped. The syndicate was prepared to put up a cash deposit of $5000 as a guarantee that it would carry out the provisions of the lease. It is understood that Thompson & McKinney, who operated the North Star mine at Kimberley for a considerable time, are interested in the syndicate, and that they will undertake the management of development work in the event of a lease being granted.——Edward and Sarkis Tergian have struck a promising vein at Markin Spur, and have drifted 20 ft. on it. The vein is 2 ft. wide and is said to average $10.40 per ton in gold.——Considerable dissatisfaction is being expressed by mining men in the Slocan camp at the Railway Commission for allowing the C. P. R. to reduce its service to the district to a tri-weekly one. The Slocan camp has had a pretty hard furrow to plow for some time, and this seems to be a further obstacle in the way of progress. The ore receipts at the Trail smelter for the last ten days of July totaled 12,761 tons, all but 265 tons coming from the company's own mines. This brings the total for the year to date to 243,143 tons.——It is understood that the White Bear Co., a subsidiary of the Consolidated M. & S. Co., which owns the White Bear mine, at Rossland, is about to reopen that old producer.

The Consolidated company evidently desires to push its gold output to the limit during the present slump in base-metal prices.

Prince Rupert.—George Clothier, resident mining engineer, recently made a trip into the Atlin district and reports that the discovery of placer gold in the Little Atlin Lake district caused a stampede recently from a number of local centres. Subsequently developments proved that there was no occasion for excitement. There are more men on the long-exploited creeks of Atlin than for the past two or three years. Individual miners are making good wages and there have been several fair clean-ups. The smaller creeks now are beginning to show well. As to lode mining, the inactivity of the Engineer mine, because of litigation, is holding back progress. With the opening of this property Mr. Clothier looks for general mining improvement.——A substantial mining company has optioned J. N. Ruffner's group of claims on Fourth of July creek, on which there are good surface showings of silver-lead ore.——While passing through here recently, H. S. Munro, general manager for the Granby Consolidated company, stated that everything was satisfactory except the price of copper. The roof of the ore-bins was being repaired. The company lost little in output through the fire, the damage of which was estimated at $30,000. Mr. Munro said that the price of living had dropped 35% at Anyox since the beginning of the year.

Victoria.—Title to the Engineer mine, at Atlin, is in the courts, once again, the point in dispute being the genuineness of the signature of Captain Alexander to the document by which he is said to have willed the property.

MEXICO

Saltillo, Coahuila.—The Cia. Minera Desarrolladora y Explotadora, of which William E. Quinn is secretary and treasurer, recently held a general meeting of shareholders at Monclove, in which district the mines are situated. ——Los Placeros Mining Co., with headquarters in Saltillo, has called for a meeting of stockholders to take place at their offices on August 29.——Torreon parties have filed on the Aguila group of mines in the Jimulco copper district. The new property is situated near La Sultana mines in the Jimulco mountains.——Miners in this district are again complaining of the lack of railroad facilities, a condition which they claim is growing worse instead of better. They are handicapped in shipments of both ores and supplies.

Torreon, Coahuila.—Heath Steele, general manager, and Dr. Sussman, president, and other officials of the Penoles Mining Co., have been inspecting the smelter plant here this week. They will visit a number of mining properties and the Mapimi smelter on a general tour of inspection.

Utah Copper Mine, Bingham, Utah

The smelter here is still operating three lead- and one copper-furnaces. It is reported, however, that no outside ores are being received; the plant will probably close down indefinitely after September 1. After this, the Monterrey smelter No. 2, which is owned by the company, may possibly be blown-in. In this event the heads of the departments will be transferred from Torreon.——A line is being constructed from the station of Rivas on the main line of the National railways to the Ramirez mountains in the vicinity of San Juan de Guadalupe. The road is being built by Albert Genty, owner of the Calaverita mines. It will be completed next month, when large shipments of ore will be made from the camp to the smelter at Aguascalientes.——Work is to be pushed on the new railroad line being constructed by Smith Bros., from Tepehuanes to the Guanacevi mining camp. It is expected that the construction will be completed by the end of this year.——A number of mining men of this district are in Mexico City this week to confer with President Obregon in an effort to rehabilitate mining conditions in general.

ONTARIO

Cobalt.—The economic situation in the silver-mining industry has lately shown some improvement with the strengthening of the price of silver and the downward tendency in the cost of material. High freights and the cost of labor still remain obstacles to the resumption of operations by several of the mines, which are expected to re-open as soon as the outlook becomes somewhat more favorable. During the first half of 1921, Cobalt mines paid dividends amounting to $1,050,000, making a total up to date of $85,531,066.——The Hudson Bay will resume operations this month. It is the intention of the management to treat all the ore that has been broken, following which they will decide whether it is advisable to engage in a campaign of further exploitation and development, or close down.——The mill of the Mining Corporation of Canada is treating a greater tonnage than ever before in its history. The ore contains an average of about 20 oz. silver per ton, and the mill is handling approximately 300 tons daily.——The La Rose Consolidated has re-opened its Violet property adjoining the O'Brien and begun active development.——During July the Bailey Silver Mines shipped 1262 tons of ore. The Bailey custom mill was operated at full capacity and treated 4043 tons of ore, realizing gross earnings of $12,129. Changes in the mill have made a higher percentage of recovery possible. The stopes at the 5th level of the mine are being timbered.

Larder Lake.—The big three-compartment shaft of the Canadian Associated Goldfields is down 350 ft.; crosscutting has been started on the 175- and 320-ft. levels. The company has solved the transportation problem by the use of a caterpillar tractor, capable of carrying 11 tons, which has reduced transportation costs about 50%.

Porcupine.—The Dome Mines, during the three months ended June 30, realized net profits of $235,697, or at the rate of a little over 20% on the issued capital, which compares favorably with the best previous records of the mine. Operations at the lower levels have been so favorable as to make it possible to treat a grade of ore much richer than in former years, and the old rate of profit distribution of 20% per year promises to be exceeded shortly. In the meantime it is officially intimated that the dividend rate of 10% will be continued, and that further distributions will take the form of capital return.——A contract has been let for several thousand feet of diamond-drilling on the Gold Island property in the Nighthawk Lake district, of which A. R. Globe has been appointed manager.——At the Beaumont, lateral work is being started at the 300-ft. level to tap veins indicated by diamond-drilling.——The management of the Triplex has decided to sink two shafts, one vertical and the other inclined, to a depth of 500 feet.

South Lorrain.—The Keeley mill, which was temporarily closed owing to the burning of a motor, is again in full operation.

YUKON TERRITORY

Mayo.—Activity is being shown in the Keno Hill district, more than 2000 claims having been staked. Among the big companies that are interested and that have representatives in the field are: The Yukon Gold Co., Bunker Hill & Sullivan interests, and the Consolidated Gold Fields of South Africa. The last recently has staked 40 claims. Edward K. Jones and associates have recently staked claims on Galena hill, where they claim to have found a 20-ft. body of ore. Indications seem to point to prosperity coming back to the Yukon through its silver-lead deposits. At a recent plebiscite the Territory voted down prohibition by a two to one majority.——The Coeur d'Alene mines of Idaho are reported to have secured options on three large groups of claims in the Keno Hill district of the Mayo camp.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

P. P. Lietzow has moved his headquarters to Las Vegas, Nevada.

George C. Crowe, of Marysville, was in San Francisco recently.

S. H. De La Mare has returned from Khartoum, Sudan, to Sussex, England.

Norman Carmichael, of Clifton, Arizona, is at Victoria, British Columbia.

R. B. Tempest, assistant chief engineer to the Utah Copper Co., is at Denver.

Nelson Dickerman has left New York on his way to Paramaribo, Dutch Guiana.

Walter Stalder has returned from an oil-land inspection in south-eastern Montana.

James F. Callbreath, secretary of the American Mining Congress, is at Uintah Basin, Utah.

C. W. Whitley, vice-president of the American Smelting & Refining Co., is at Salt Lake City.

C. A. Richardson, manager of the Chambers-Ferland mine, at Cobalt, Ontario, is now in London.

Edward Higgins has returned to San Francisco after a visit to the iron and copper mines of Michigan.

K. Yoshizawa, mining engineer to the Mitsui Mining Co., was in San Francisco on his way to New York.

J. T. Grayson, we are glad to say, is out of the hospital and convalescing at his home in San Francisco.

John T. Reid has returned to Lovelock, Nevada, from New York, where he has been for the last five months.

George W. Heintz, of Boston, vice-president of the U. S. Smelting, Refining & Mining Co., is at Salt Lake City.

Richard B. Moore, chief chemist to the U. S. Bureau of Mines, was here this week, and is now at Reno, Nevada.

N. F. Dare is now the manager for the Chenderiang Tin Dredging Co., in the province of Perak, Federated Malay States.

Richard L. Lloyd, of the Dwight & Lloyd Metallurgical Co., has been granted the degree of M.Sc. of Washington University, St. Louis.

Alfred James has resigned from the council of the Institution of Mining & Metallurgy, of which society he was at one time the president.

William Kemnitzer has returned to Palo Alto from Nevada, where he studied the evidence of seismic action as an assistant to Dr. Branner.

Jose Zakany, manager for the Placeres de Oro de Michoacan and the Placeres de Oro de Bacubirito, in Sinaloa, Mexico, is at the Palace hotel.

B. G. Hood, president and general manager for the Canyon Queen Silver Mining & Milling Co., of Reno, Nevada, was in San Francisco this week.

Arthur B. Parsons, Associate Editor of the 'M. & S. P.', visited the Kelly mine, at Randsburg, California, last week. He went from there to Tonopah.

Heinrich O. Hofman, Professor of Mining in the Massachusetts Institute of Technology, has been elected to honorary membership in the Institute.

A. J. M. Sharpe has retired from the managing directorship of H. S. Willcooks & Co., to take over the direction of the International Metal Service, in London.

James G. Ross, consulting mining engineer for the Milton Hersey Co., of Montreal, has returned from an extended examination trip to the northern interior of Quebec.

THE METAL MARKET

METAL PRICES

San Francisco, August 16

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.50—13.00
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$75
Platinum, 10% iridium, per ounce	$93
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

August 15.—Copper is inactive but steady. Lead is quiet but firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 9	60.00	36.25	July 4	58.90	35.33
" 10	60.87	37.00	" 11	58.69	36.75
" 11	60.87	37.50	" 18	60.25	37.56
" 12	60.87	37.50	" 25	60.14	37.85
" 13	61.00	35.87	Aug. 1	61.66	39.05
" 14 Sunday			" 8	61.46	38.62
" 15	61.25	38.00	" 15	60.81	37.02

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Aug. 9	11.75	July 4	12.62
" 10	11.75	" 11	12.62
" 11	11.75	" 18	12.62
" 12	11.75	" 25	12.43
" 13	11.75	Aug. 1	12.04
" 14 Sunday		" 8	11.75
" 15	11.75	" 15	11.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 9	4.40	July 4	4.43
" 10	4.40	" 11	4.43
" 11	4.40	" 18	4.40
" 12	4.40	" 25	4.40
" 13	4.40	Aug. 1	4.40
" 14 Sunday		" 8	4.40
" 15	4.40	" 15	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Aug. 9	4.70	July 4	4.75
" 10	4.75	" 11	4.77
" 11	4.75	" 18	4.76
" 12	4.70	" 25	4.72
" 13	4.70	Aug. 1	4.75
" 14 Sunday		" 8	4.70
" 15	4.70	" 15	4.72

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Aug.	
July	19 47.50	"	2 47.50
"	26 47.50	"	9 47.50
		"	16 47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

THE OUTLOOK IN BRITISH STEEL

British steel manufacturers are staggered by the magnitude of the difficulties they now face, states 'The Iron Age'. The coal strike has been settled, but iron and steel manufacturers cannot go ahead at the high prices they must pay for fuel. The boom of 1919 and its overhang in 1920 pushed the British steel market pounds per ton above what German, Belgian, and French makers were willing to do. After the coal-strike settlement, British prices came off from £3 to £5 per ton, but they are still so far above those named on the Continent as to put British works out of the running as to most of the current export trade. In a recent statement issued jointly by the National Federation of Iron and Steel Manufacturers on behalf of employers and the Iron and Steel Trades Confederation for the workmen, the opinion was expressed that "in view of foreign conditions the industry will not be able to export unless fuel as well as other items of cost are reduced to a level not higher than from 75 to 100% above pre-war". The statement further says that the difficulties now confronting the industry "are not of its own making nor within its control; they exist largely from political causes and appear to us to require Government attention".

The London 'Ironmonger', in commenting on this statement, expresses surprise that the steel industry, "which was among the first to demand the cessation of all Government interference, should now begin to talk of Government assistance".

There is no question that high fuel and labor costs will continue for a long time to be a serious handicap to British steel manufacturers in the export trade. Production of British steel will not resume on any scale until the price of coal comes down 50% or more and it will be many a day before such a drastic readjustment can take place, with the control of coal production and prices so largely in the hands of the labor unions. It seems likely, moreover, that Continental steel will be increasingly a factor in the British market. There is scarcely a quotable market, in fact, in British material, the business done being in the smallest quantities and from accumulated stock. The nearest approach to the real steel market in Great Britain today would be the quotation of prices now being paid there for Continental iron and steel.

It is true that the British steel industry has always pulled through—just as the nation has been able to pull itself together when there seemed nothing ahead but disaster. Doubtless the way will be found at length out of the dangers that now loom up so threateningly; but it must be said that the pessimists have most of the facts on their side as the case stands today.

MONEY AND EXCHANGE

Foreign quotations on August 16 are as follows:

Sterling, dollars:	Cable	3.65
	Demand	3.64½
Francs, cents:	Cable	7.72
	Demand	7.70
Lire, cents:	Demand	4.33
Marks, cents		1.11

Eastern Metal Market

New York, August 10.

"Stationary as to price but slightly more active as to demand", characterizes all of the markets.

The bottom of the copper market is believed to have been reached, and buying at present levels is better.

Demand for tin is moderate. Prices have advanced.

The tone of the lead market is better, and buying is on the increase.

Inquiry for zinc has developed and there have been more sales.

IRON AND STEEL

The moderate improvement of the past two weeks in replenishment demand for steel continues, but few successors have appeared to the larger-sized orders that lately brought out such keen competition in the Central, Western, and Chicago districts, says 'The Iron Age'. Any new price concessions have been in pig-iron rather than in finished material.

Steel, like pig-iron, fell off 20% in July from the output in June. The ingot statistics published this week show 803,376 tons produced by 30 companies last month, indicating 950,000 tons for the whole industry, against 1,190,000 tons in June. The July rate represents about 11,500,000 tons per year, as against a rate of 30,000,000 tons per year in January and an actual output of 40,881,000 tons in 1920.

On larger buying than in many weeks pig-iron in eastern Pennsylvania shows a fresh decline of $1 to $2 per ton. The largest lot was 5000 tons of basic bought by an Eastern steel company at $19 at furnace. Foundry iron also went to a new low level for the year, considerable sales being made at $18.50, eastern Pennsylvania furnace, for No. 2 plain and $19 for No. 2X. Lower quotations are reported also from the Buffalo district, No. 2 being offered considerably under $19.

German and other European bids on steel for Japan are well below American prices. French sheet bars have been offered at $34.70, delivered in Japan, or $11 to $12 under anything domestic mills would do.

COPPER

Attempts by consumers and dealers to break the 12c., delivered level for electrolytic copper by bidding 11.75c. have proved futile. Inquiry, partly with this object in view, has been plentiful; it is now stated by one or two sellers that such inquiries have resulted in moderate sales at 12c., delivery, which seems to be bottom at which any one will sell. Some large producers, however, will not quote at all, and announce they are out of the market. It is believed by those who are selling that 12c. marks the bottom and that possibly the turn in the trend has come or at least has started. A more cheerful feeling prevails. There has been a reduction in the ocean freight rates from $9 to $5.50 per ton to Hamburg, which is expected to stimulate foreign buying which at present is light.

TIN

The market is only moderately active but prices are higher, due largely to advances in exchange which took a decided jump on Monday. There were two moderately active days last week, on one of which about 300 tons of future shipment from the East was sold at 26.25c. down to 26c. and on the other about 100 to 150 tons, also Eastern shipment, at 25.75 to 26c. With the advance in prices on Monday to 27.75c., New York, there was a fair amount of business at 27.50 to 27.75c. Spot Straits yesterday was quoted at 27.75c., New York. London prices were about £4 per ton higher than a week ago, at £162 10s. for spot standard, at £164 5s. for future standard, and at £163 5s. for spot Straits. Arrivals thus far this month have been 260 tons with 4010 tons reported afloat.

LEAD

The market is a little more active, with sales on the increase rather than otherwise. The New York price of the leading interest and of the outside market is still 4.40c., at which price business is being done. At St. Louis the asking price of the leading producer is unchanged at 4.40c., independent sellers quote 4.20c. with the tendency upward.

ZINC

Sellers report a better tone and are more sanguine than in some weeks. Inquiry from galvanizers and brass makers, particularly the former, is more active and of a more substantial and definite character than in some time. This has resulted in sales of moderate proportions for both August and September delivery. There is still some prime Western available at 4.20c., St. Louis, but it is believed to be fast disappearing. Some sellers report sales at 4.20 and 4.25c., St. Louis, for August delivery, with September about five points higher.

ANTIMONY

The market is quiet and unchanged at 4.60c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading producers at 24.50c. per pound f.o.b. plant, for wholesale lots for early delivery. The same grade imported is quoted at 21 to 23c., New York.

ORES

Tungsten: The market is unchanged and prices are nominal at $3 per unit and upward, depending on the grade and the delivery.

Ferro-tungsten: Ferro-tungsten is quoted at 55c. per pound of contained tungsten in lump form, guaranteed as to quality.

Molybdenum: The market is without life, and quotations are unchanged at 55c. per pound of MoS_2 in regular concentrates.

Manganese: For high-grade foreign ore, quotations are nominally unchanged at 22c. per unit, seaboard.

Iron-Manganese Alloys: There is more life in the ferromanganese market, and sales of about 500 tons are reported, mostly at $70, delivered, which is the prevailing quotation for domestic alloy. British sellers are now quoting $65, seaboard, but are taking few orders. Business in spiegeleisen is confined to small lots at $25 to $27 per ton, furnace.

Ferro-silicon, 50%, is a little firmer at $65, delivered. Those who have sold as low as $60 are inclined to withdraw this price.

According to the report of the representative in Mexico of a large American bank, economic and political conditions there are good and progress under the present administration rapid, states 'The Iron Age'. Train schedules throughout Mexico are greatly improved and receipt of the locomotives and rolling-stock purchased in the United States recently is expected to relieve all congestion at the ports. He adds that the administration is preparing to make payments on all foreign debts.

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T. A. RICKARD, ... Editor

IN our news columns will be found a brief account of a remarkable record in shaft-sinking made by the Walter Fitch Jr. Company, at Eureka, Utah. A three-compartment shaft was sunk and timbered for a distance of 427.5 feet in 31 consecutive days, making an average of 13.8 feet per day. The best previous record is believed to be the performance of the Crown Mines, Ltd., at whose mine 310 ft. was made in a 31-day period two years ago.

OUR issue of August 13 contained a letter signed "E. M. West", attacking the Cornucopia Divide Mining Company. This letter, we now learn, was a gross breach of good faith; the signature was a fake, the writer being Albert Erickson, who vented a personal spite in attacking the controllers of this company, which, we find, is operating under a permit from the Commissioner of Corporations and is directed by worthy citizens, among whom we may mention Mr. P. W. Pray, president, Mr. J. C. Downey, treasurer, Mr. C. E. Butler, Mr. W. B. Harrington, and Dr. W. F. Schwarner, all business men of Oakland. We apologize for publishing the letter attacking this company.

UNDER 'Discussion' this week we publish a particularly useful and public-spirited letter from the Dean of the College of Mining in the University of California. It is on the subject of indexing, which was discussed recently in these pages. Then comes a protest from Mr. Harai R. Layng, who objects, quite properly, to our omission to take note of his contributions on the subject of volatilization. We apologize unhesitatingly. The proposed revision of the mining law is again criticized feelingly by sundry readers to whom it is a matter of personal interest. Mr. George L. Sheldon, of Denver, is an 'old-timer' whom we know personally to be a genuine prospector and 'mining man' of the best type. He objects, as others have done, to the proposed regulation compelling the description of locations in terms of cardinal lines. He believes that the change would be hard on the average prospector and would handicap him to the advantage of the big mining companies, which have the services of a surveyor at their command. The Mexican system of making locations is cited as one that we ought to imitate. Next comes Mr. W. K. Whitmore, of Mojave, who recites his experiences in Alaska to show how the regulations impede the real adventurer to whom the expansion of the mining industry is so largely due. With his attack on the trading and transportation companies in Alaska we sympathize, because we have personal acquaintance with the conditions obtaining on the Yukon. Undoubtedly they did kill the goose that laid golden eggs for them, for they hindered the exploration and development of the region in the years that are past, and exercised power in an arbitrary and selfish way. As to the location of groups of claims by one man under power of attorney, that is an abuse of the law to which the real prospector and any other good citizen has every right to object vehemently. It has hindered the advancement of Alaska and has been instrumental in bringing it to its present low state of industrial activity. Another contributor, Mr. F. J. Kirby, imputes the decay of prospecting to legal red-tape. He makes several radical suggestions. Mr. G. L. Holmes, writing as a mining engineer, endorses the prospector's plaint, for he believes that the new regulations will play into the hands of the land-grabber. He recites an incident from his own experience to show how the cheaper kind of mining stock is boosted on the local exchanges. He also objects to the location of claims in accord with the subdivisions of the Land Office, and suggests that there can be too many legal tangles in regulations that ignore the eccentricities of ore deposits. The most important point to which he draws attention is the inevitable conflict between the old and the new law, when the old apex rights come into conflict with the proposed 40-acre tracts without extra-lateral privileges. To us this objection seems logical.

MANY a mining enterprise has suffered serious loss as a result of stupid orders sent from Eastern offices by officials who knew little or nothing of local conditions at the mines. Early this month about 215 men, comprising the entire force of miners, mechanics, and construction laborers at the property of the Darwin Silver Company, in Inyo county, California, were summarily discharged and paid off at the direction of a representative from the administrative office at Chicago whose mission, according to reliable information, was unknown to the operating officials until his arrival at the mine. Any engineer who is familiar with operations in such an isolated district can realize the demoralization that ensued. Darwin is 40 miles from Olancha, a station on the Southern Pacific Company's branch line from Mojave in California to Sodaville in Nevada. The road connecting the mines with Olancha is at present about as bad as can

be imagined, and Olancha itself is a night's journey from Los Angeles, the nearest large city. The wholesale migration from Darwin is pitiful. There are no operating mines or large construction projects in the vicinity of Darwin, with the exception of the California Rand silver mine at Randsburg, and no considerable number of additional men are required there. The hardship that this unexpected shut-down brought upon the employees is accordingly apparent; and of more importance to the enterprise itself is the bad reputation that will necessarily attach to the company and its operations. The company had just completed a 50-ton pilot mill, preliminary to the erection of a 300-ton plant for the treatment of its lead-silver ore; it had begun the construction of commodious boarding-houses and warehouses, as well as various shop-buildings and staff quarters; and it has on hand new machinery and equipment valued at several hundred thousand dollars. The total investment for improvements during the last two years is probably more than a million dollars. According to the last report of Mr. E. W. Wagner, the president, the mines themselves have been commended by Messrs. Robert W. Hunt & Co., of Chicago, and by Mr. A. G. Kirby, who is now general manager for the Darwin Silver Company. It is possible that financial difficulties made a temporary suspension of operations unavoidable, but we have reason to believe that such was not the case. In our opinion the order would not have been given if the officials at Chicago had had sufficient experience to realize the difference between discharging 215 men at Darwin and discharging the same number at Chicago. Their mistake was the failure to consult with the manager at the mine.

The Status of Silver

In commenting on Senator Pittman's remarks, made recently at a meeting of the Mining & Metallurgical Society of America, and reproduced elsewhere in this issue, on the history and status of silver during recent years, Mr. C. W. Handy drew attention to the demand for silver, from the geographic and economic aspects. The United States, he pointed out, is young as compared with European countries, but the latter are young as compared with the Far Eastern states of China and India. Civilization had advanced in the Far East for centuries before Europe made much progress, and has handed down its customs to the present generation. Starting with the custom of bartering goods for goods, the Orientals advanced to the exchange of goods for rare stones or metals, finally adopting silver or gold as standards of value and means of exchange. These were adopted for the same reason that today we find them convenient for the same purpose. To appreciate the demands of those countries, it must be remembered that the population of China is estimated at about 400 millions, and that of India at 335 millions, all trading to some extent, but uneducated to modern methods of finance. A dollar placed in the bank has no significance to the majority of these people; they want, and they demand, hard metallic money that they can see and feel and use when they wish to buy. The British government has been educating the Indian people gradually to use the rupee note instead of silver; but as yet only 418 banking houses have been established to serve over 300 million people. The old customs are hard to change. The people want the silver; and, having obtained it, it disappears forever, or until hard times force some of it on the market, in the form of coin or jewelry. In China, Mr. Handy added, the monetary unit is not a coin. A weight of silver called a tael (outside the country) is the basis of exchange; but there are about 65 tael standards in use. These vary in fineness as well as in weight, thus involving complications in exchange dealings. Although the rupee is the unit of value in India, a great deal of misconception arises outside that country, because India regards the question as one of bullion rather than of currency. The people choose to set their own ratio between gold and silver currency. These two metals are looked upon as commodities, and the imprint of a die is only an official certificate as to contents. From this conception it is easy to understand why Great Britain had difficulty in educating the Indians to the use of paper currency, and why she has permitted those people to melt their coins into bullion when they wish to do so, a privilege that is denied to the citizens of the mother country.

In addition to the extraordinary demands of India for silver during the War, as pointed out by Senator Pittman, Mr. Handy showed that the requirements of China were abnormal. This country, during the earlier stages of the contest, had sold silver to India at a high price, and needed to replenish her stock. Russian paper rubles, which had been used in northern China, became valueless; silver had to be imported to take the place of that depreciated currency. The present low price of silver in the world's markets is the point of chief interest. Ordinarily, the law of supply and demand determines the price of any commodity, including silver. The demand exists throughout the Far East, as it exists in all European countries. With so small a supply of silver, why the low price? Simply this: those countries desirous of obtaining silver have little or nothing with which to purchase it. Trade is now strongly against India, as we pointed out in a recent issue; hence no silver is bought and sent there to liquidate balances. There is no balance in India's favor. On the other hand, India must settle her balances abroad, and that means she must ship her store of silver out of the country. Another factor in lowering the price of silver has been the quantity of melted coin that has become available of late. London reports that, in 1920, between thirty-five and fifty million ounces of melted silver came on the market, partly through the reduction of the fineness of the British silver coins from 925 to 500 parts per 1000. This is equivalent to doubling the supply of bullion in the British empire for the manufacture of its silver coins. Fear was expressed for the time that the British government might throw some of the silver on the market; this stimulated selling and caused a depreciation of market-value,

such as would not have occurred under normal conditions. Mr. Handy concluded by stating that recent advices from Europe and from the Far East indicate a condition that is not as encouraging as Senator Pittman would have us believe; but the present price of silver is so low and the supply is so small that it is difficult to see how the market can drop much farther. We note that Mr. B. Lenox Simpson, adviser to the Chinese government, has recently issued a statement to the effect that researches, instituted by the Bank of China, had resulted in the disclosure of interesting information anent the disappearance of silver coin, by hoarding, in Manchuria and in the metropolitan province of Chihli. It is estimated that, in each area, from 10 to 15 million silver dollars had been withdrawn and hidden since the coining of the Yuan Shi Kai dollar commenced on a large scale in 1914. It is concluded, therefore, that in the 22 provinces there might be hidden an amount that varies between 100 and 150 million silver dollars. The larger of the two estimates represents about 150 million ounces of silver. It is suggested that this might begin to appear on the restoration of general industrial confidence.

The Strike at Tonopah

Although the miners and craftsmen of Tonopah have officially declared an end to the strike that started on April 16, thereby accepting the full cut in wages, amounting to about 12½%, that was imposed by the companies, conditions are still far from satisfactory. The mines and mills are all in operation at maximum capacity, and to the casual observer the town and its industry seem to be thriving. The contrast with Goldfield, which for the present at least is a derelict indeed, emphasizes the material prosperity of Tonopah. But it will be many months before the premier silver-mining district of Nevada recovers from the effects of this four months strike; there exists an undercurrent of ill-will that only time can cure. If mistakes were made, and we believe they were, they cannot be undone now; but there may be profit in reviewing frankly the story of the strike with the hope that such a review may be helpful in averting or in adjusting such future disputes as may threaten or occur, not only at Tonopah but in other mining districts. Until a few years ago the mining companies at Tonopah had little serious trouble with their employees; the scale of wages was high; the mines were comparatively safe and healthful; the men generally did a good day's work; the town was not entirely free from agitators but the better element among the workers was so strong that the irresponsible element was discountenanced. Later, however, the radical labor leaders began to gravitate toward Tonopah and their followers went with them. The theory of radicalism is that no matter how high wages may be, they are too low; and that no matter how good conditions may be, they are not good enough. In due course demands were made for higher wages; not once, but several times. It is only fair to say that at first the rising cost of necessaries and amusements made these increases reasonable; but the last one, in 1920, followed a peremptory demand the justice of which was questionable, to say the least. The mining companies acceded, not, however, without protest from some who felt that compliance with demands which they believed to be unreasonable would add to the arrogance of the radical leaders. The "abject surrender", as it was called by some of its opponents, was made, but the memory of it continued to be a sore spot in the minds of many of the executives, some of whom were in Eastern offices. They hungered for an opportunity to give the miners some of their own medicine. Last spring the decrease in the cost of living prompted a general reduction in wages; the companies that mined copper, lead, and zinc made reductions that averaged between 75 cents and $1 per shift. They had the additional argument of a poor market for their products. On the other hand, the companies at Tonopah had the advantage of the Pittman Act as well as the diminished cost of the supplies and commodities that they used in operating their mines. Nevertheless the employers felt, we believe rightly, that they were entitled to profit by these things and that they were justified in reducing wages to a point where they were in the proper proportion to the cost of living. At this time the closing of the copper mines flooded Tonopah with miners. How much influence this fact had upon the way in which the companies put the decrease of wages into effect is debatable, but it is alleged that a spirit of vindictiveness, caused by the peremptory manner in which the last increase had been obtained, found vent in the curt announcement only a few days before April 15 of the cut to take place on that date. It has been stated that the orders came from the Eastern offices of the companies and that many of the local officials would have favored longer notice and an opportunity for the miners to discuss the question of the actual drop in the cost of living. As to this we do not know, but we do know that in matters pertaining to the treatment of employees, the judgment of the men at the mine ought to be given more weight than is sometimes accorded. Whether a more politic course would have averted the strike no one can tell, but certainly it would have made the work of the radical agitator much more difficult. We are inclined to believe that the companies played into the hands of these 'leaders' by their arbitrary and sudden action.

Another unfortunate feature was the lack of unity among the companies. In a small town where there is but one industry and where the identity of individuals is not lost, it is essential for the welfare of the community that there be no antagonistic factions among the workers. The existence of such factions in Tonopah today is the result largely of the failure of the companies to act in unison. One of them did not join the others in making the cut; we are informed that the reason was that certain financial obligations had been incurred and that they could be met only by the continued production of silver bullion. It is unfortunate that some other financial arrangement could not have been made. Soon after the strike was declared another cleavage developed between

the companies. Two of them started to import miners and millmen; these they lodged and boarded in new barracks erected near the mines and at some distance from the town. The imported men naturally aroused the enmity of the strikers. The merchants and business men of the town, unable to agree as to whether they should support the striking miners or the company men, were driven into opposing camps, although most of them favored the strikers. The two remaining companies, on the other hand, preferred to close their mines and await a settlement of the strike, which under the circumstances was certain to end in a victory for the employers, although the duration of the strike itself was uncertain. Thus there were three groups among the employers. By the time the two companies who were importing men had obtained full crews, the strikers were ready to acknowledge defeat and declare the strike at an end. This they did on August 9. The two companies that had discontinued operations immediately hired such of their old men as had remained at Tonopah, together with many of the strikers from the mines and mills that were being operated by the strike-breakers. The employers who imported the new men must retain them, but they are afraid to mix the new and the old. Apparently they must continue to maintain their special dormitories and boarding-houses and the men will continue to live as in a hostile camp, hated by the strikers and shunned by the people of the town. A man known to be a strike-breaker cannot obtain a meal except in the company camp. Obviously this state of affairs is not only disagreeable to all concerned but it hurts the town. We hope that some way can be found to end the impasse. Recent developments in the mines have been highly satisfactory and the outlook for profitable and continued production has never been better. Circumstances make Tonopah the most prosperous mining district in the country today; indeed, it is no exaggeration to say that for the moment it is *the* most prosperous community in the United States. The recent strike was costly to the companies, the employees, the community, and to the State of Nevada. It emphasizes again the need for deliberation and fairness on all sides.

Financial and Economic Engineering

That skillful engineering can be applied outside the domain of mechanics has been demonstrated by the ingenuity and purpose displayed by Mr. Henry Ford in extricating his company from the position of financial insecurity that resulted from the general industrial depression prevailing during the early months of the year. Obligations to be met between January 1 and April 18 totaled $58,000,000; cash in hand amounted to $20,000,000. How was the remainder to be obtained? The story forms an interesting page of American industrial history; it may be garnered from an interview that recently appeared in the 'Detroit News'. In January, the Ford plants were closed; the Government was owed $55,000,000 for taxes; notes for nearly $30,000,000 would soon be due. The demand for cars was at a low ebb; stocks were high, both in the factory and throughout the country. Wall Street, confident that Mr. Ford could not weather the crisis without aid from the bankers, proffered assistance, for a consideration. Loans were suggested. Only one banker succeeded in obtaining a personal interview for this purpose; but he was overconfident that Mr. Ford was dependent on help from the outside; the banker was dictatorial, in spite of the manufacturer's assurance that he need not borrow. The interview was terminated abruptly; "I handed him his hat," says Mr. Ford. Within twenty minutes Wall Street discovered that no help was needed. The Ford employees were called back to work; within six weeks the plant was again in full operation; 3000 cars were produced in January, 35,000 in February, 60,000 in March, 90,000 in April, 110,000 in May, 116,000 in June. On July 12, 4461 cars were manufactured; the output for the whole of last month exceeded all records; and yet production was below demand. In attempting a feat that, as the 'New York Times' says, will go down in the annals of financial history as one of the most remarkable achievements of post-war liquidation, Mr. Ford realized that the problem could be solved by liquidation and economy. He ceased to buy. He then turned all his stock in hand into cash, he eliminated what was unproductive, and forced his enterprise, for a time, to live upon itself. The first obligation to be met was the payment of a bonus to employees for services during 1920, which absorbed $7,000,000. Attention was next turned to liquidation. In the company's contracts with dealers it was agreed that a certain quota of cars should, if circumstances demanded, be taken each year, according to the size of the district. Cars were then sent to those that wanted them, as well as to those that did not want them; agents were told of their legal obligation, and of their indebtedness to the Ford company. Future prosperity involved immediate co-operation. The plan succeeded; 57,000 cars were sold in January, 63,000 in February, 87,000 in March, and 100,000 in April. Between January 1 and April 15, stock valued at $24,700,000 was turned into cash; foreign collections amounted to $3,000,000; sales of by-products netted $3,700,000; Liberty bond sales brought $7,900,000. A vast amount of money was tied up because of delays in the transit of goods; this condition was remedied, with the result that $28,000,000 was released. Economies were effected in the plant; the average daily output of about 4000 cars is now obtained with 15,000 fewer men than formerly. The $6 minimum wage has been retained, but foremen have been set to work, tasks have been 'doubled up', and adjustments have been made that aided in the consummation of a plan that, for its very boldness, merited the success which resulted. Thus, by April 1, Mr. Ford had $87,000,000 in hand to meet $58,000,000 in obligations, all of which were paid well in advance. From such an account we may infer that engineering can be applied to organization and finance, to the discomfiture of the bankers and for the conservation of industry.

Indexing Current Technical Literature

The Editor:

Sir—Readers of your paper who regularly study its columns in order that they may keep abreast of the wave of current thought and practices in mining and metallurgy, will, I am sure, share with me the endorsement of your leading editorial of August 6. You have not wasted words, for in every paragraph is some constructive thought, which, if acted upon, should result in something tangible and worth while.

For twenty-five years I have been a regular subscriber to the leading technical magazines relating to our professional work; the volumes are bound in distinctive colored binding and constitute a large part of my technical library. I also have the several indexes mentioned in your editorial, and, after diligent search, have found them useful. The index to current literature presented in the monthly of the Institute is one of the best things in what is otherwise a superfluous addition to the A. I. M. E. voluminous publications; the topic headings are acceptable, although some of the subdivisions are too comprehensive for my needs, but I find them of great value. It is perhaps unfortunate that so many other societies and engineering magazines should attempt the same task, more or less incompetently. I cannot think that it is the prerogative of any individual or concern to control this field, but believe if the American Institute of Mining and Metallurgical Engineers is conceded to be our representative society in the United States it might properly sponsor your suggestion and carry it out with profit to itself and great benefit to the profession. If it is to be attempted, it should be well done.

Before proceeding further I wish to pay tribute to the 'Table of Contents', always found prefacing your editorial columns. This I have found extremely helpful, and after reading the 'Press', this page is 'clipped'; the résumé of articles in which I am particularly interested is pasted on a card and placed in my ready-reference files. I have my own elaboration of a decimal index, and on turning to a card I immediately have before me a synopsis of the article, often sufficient to refresh my memory on the essential facts. I have but two suggestions to make, and hope you will see fit to incorporate them in future issues.

1. That you indicate by an asterisk the articles that are illustrated and

2. That, following the abstract, you add the name of your paper and the volume, as, for example, "M. & S. P., Vol. 123, page 180".

I agree with you, Sir, that an index of titles only is of little value; the caption is frequently misleading, and even though appropriate gives no clue as to the manner in which the subject is presented. I know whereof I speak, for in the discharge of my professorial duties I endeavor to keep in touch with the latest thought on the subject about which I am to lecture. Every day of the academic year I consult my index and have wasted much time turning to volume and page only to find perhaps half a dozen lines or so on the subject.

It is highly desirable that all sources of information be scanned and culled, for mining is practised beyond the Rockies, and there are men with powers of observation, inference, and expression beyond the borders of the Americas. On the subject of petrodynamics and surface subsidence, for example, while excellent work has been done by Dr. F. W. McNair of Michigan and Dr. H. H. Stoek of Illinois, the French engineers have prepared and presented a wealth of information in government reports, and the Department of Mines in South Africa and Australia are far in advance of our own committee of the Institute on this important matter.

Cross-indexing may be carried to such an extreme that its purpose is defeated; however, in this detail there is much room for improvement. My pet hobby for years has been the study of the outcrop. I have never seen an index of technical literature that calls attention to this important subdivision of geologic knowledge. Abstracts of the U. S. Geological Survey reports, relating to the surface signs of ore deposits, excerpts from other papers and periodicals properly summarized and catalogued should be of great service to any student of the subject.

Platitudinous compliment of your plea avails nothing without action. I shall be glad to collaborate with you or any other competent body in the preparation of an index to current technical literature by assuming responsibility for the compilation in synoptic form of data relating to a particular phase of mining work. Example is better than precept. Next, please!

Frank H. Probert,
Dean, College of Mining,
University of California.

Berkeley, August 10.

[This letter shows a splendid spirit of co-operation and we are delighted to publish it. We would suggest that Professor Probert make a start in systematic indexing by making 'Outcrops' his special subject. The attention of the Institute is invited to his offer. His suggestions for

the improvement of our own 'Table of Contents' are welcomed and accepted. We used to do exactly what he suggests, but stopped the practice, thinking it was not appreciated. We resume herewith. We shall be glad to hear from others on this subject of 'Indexing'.—EDITOR.]

Chloride Volatilization Process

The Editor:

Sir—The article on 'Chloride Volatilization Process' and your editorial note on the same subject appearing in your publication of July 30, 1921, are quite interesting to me.

I note that, at the U. S. Bureau of Mines Experiment Station, use is being made of water-vapor. This subject was disclosed by me in an article appearing in your issue of January 17, 1920. I have covered the use of water-vapor in conjunction with chloridizing volatilization by an application for patent, which has been pending for many months.

The rapidity of the expulsion of the chloridizer was disclosed by a chart in my article. The plant that I designed, erected, and tried during the latter part of 1920 and the early part of this year was designed so that the chloridizer could be added at any desired point between the point of feeding and the point of discharge, because experiments on the ore in muffles had shown that the chloridizer was expelled before appreciable quantities of the silver could be volatilized. I have covered this method also by means of a patent application.

Contrary to the impression conveyed by both the article and your editorial note, which is to the effect that the Cottrell system is the only system for recovering the fume, I have obtained practically complete recoveries of chloride fumes by means of bags and by means of both laboratory and large-sized scrubbing-towers. This is better work than, so I am advised, the Cottrell system will do. I wish to call attention to the statements relative to this subject appearing in my previous article. I have covered the use of limestone-filled scrubbing-towers in chloridizing volatilization processes by means of a patent application filed many months ago.

I do not agree with your editorial statement to the effect that most of Mr. Croasdale's suggestions and conclusions have been favored by adoption at the hands of later sponsors. Mr. Croasdale certainly deserves credit for the principle of applying chloridizing volatilization for recovering metals; but that is only as far as his suggestions could have been followed by me had I known of them when I started work on chloridizing volatilization. I did not learn of Mr. Croasdale's work nor of the work of others until some months after I had started work on chloridizing volatilization. I do not use any of the methods suggested by Mr. Croasdale—the principle of chloridizing volatilization excepted. In this respect I again wish to call attention to my previous article.

Revolving furnaces are not the best furnaces for chloridizing volatilization. I erected a stack furnace in combination with a short revolving furnace. The short revolving furnace was a convenient continuous-discharge device and it would permit a longer treatment than could be obtained by the stack furnace alone, should such longer treatment be required. This furnace produced better results than those obtained by laboratory methods. The extraction was obtained in less than nine minutes and probably less than one minute. The temperature of the gases leaving the furnace was about 300°F. and they could be drawn off at a lower temperature; therefore the furnace would consume less fuel than a revolving furnace. The stack-furnace trial proves, on a large scale, the advantage of rapid heating, which method I disclosed in my previous article. Recent action on a patent application covering rapid heating indicates that a strong patent will be allowed.

Your editorial note was not generous toward my work.

HARAI R. LAYNG.

San Francisco, August 2.

[We accept Mr. Layng's correction and admit that his researches might well have been mentioned by the Bureau of Mines' engineers in the article to which he refers. We apologize for our remissness in not counteracting this omission by drawing attention to his work in our editorial columns. We wish Mr. Layng success with the volatilization process, as well as with the Patent Office.—EDITOR.]

Revision of the Mining Law

The Editor:

Sir—Criticism being desired of the proposed new mining laws, as revised by Winchell and others. From the proposed change of locating by legal subdivisions, it appears to be the desire and intent to kill off what little incentive there still remains for the prospector, who is always a poor man, to get out and find new mines or mineral areas. No better method can be found.

It is beyond the possibilities of the prospector, like those who have heretofore discovered nearly all of our mines, to comply with the new requirements. Those who know our mineral regions are well aware that outside of new veins, or rather new ore-shoots on known veins, in the older camps, we have but small chance of making new discoveries, only as we get into present unknown areas of well-known mining districts. In these, 90% of them is pretty certain to be found at long distances from surveyed lands. The discoverer of new mines must employ the services of a civil engineer, which may often run into absolutely prohibitive costs to the prospector. At this stage of the game he will find it practically impossible to get financial assistance.

Our present law has worked no hardships on anyone. Why the desire to change? Is it intended, as some of our learned engineers lately contend, that new prospecting must be done by the trained geologist and engineers, with picked practical men under them, and combing geologically favorable areas? Then this proposed change will accomplish the object, as only such a corps of men under the hire of the largest mining companies can stand such

expense. Look at Alaska, rich in minerals; it has lost one-half of its white population during the last decade, largely owing to the governmental red tape and Coal Leasing bill—three leases taken out since its inauguration! What about fractional claims, left in old surveyed mining districts, under the proposed change?

All of our Western States were only developed by the liberal mining and agricultural land laws and their interpretations. If the possibility of large capital acquiring large areas by fraud is avoided, their continuance is to the benefit of all. If it is insisted that future locations must comply with the legal subdivisions, then let Uncle Sam, or the State in which situated, do it for the prospector. The State is the largest beneficiary.

It is not right or fair to compel the prospector to perfect his location by also filing his location, by legal subdivisions, with the nearest United States Land Office. His records always have rightly been with the County Recorder, where he can secure a proper abstract at any time.

It is probably desirable that the nearest Land Office have this record, but why not let the County Recorder send a copy of same to the Land Office? He receives a good salary; why not help him earn it? There are always many seeking the office. But do not further discourage the poor prospector (the only one who finds new mines) by adding additional red tape and expense to his present difficulties. He is nearly extinct now!

A vast improvement can be made over the present or proposed new laws as to the marking of the boundaries of the claims. The Mexican system beats ours. This requires that there shall be a substantial monument of stone or rock and mortar, two feet square and as high (under their metric system, a trifle less) erected at each corner of each claim or group of claims, and then around the outside boundary of each. The monuments must be so placed, of such size and material, in such a position, owing to the topography of the country, that from each monument the one in front and the one behind on the line can be seen, that is, there are always three monuments discernible.

To the above requirement should be added the compulsory one of cutting in the stone, or in the mortar when soft, the patented numbers of the claim or group in figures. This is the policy that I pursued in monumenting claims in Mexico. These monuments must always be kept in place; it is then easy for anyone to ascertain exactly where the lines are, and no expensive surveying work, which again discourages the prospector.

As our Supreme Court has decided that the monuments upon the ground, rather than the written patent, govern, this is of the utmost importance; we ought to have permanent and easily found stone monuments. To those familiar with the old camps, it is a well-known fact that the present system, discretionary with the U. S. Mineral Surveyor, is a farce. In the great majority of cases a wooden post is erected, with the number of the patent cut into it, and erected only at the four corners. Cattle may rub this down, the storms and snowslides may carry it away, or sometimes a lazy man takes it and cuts it up for fire-wood. But the fact is that they are very often gone. This requires an examination of the records and the employment of a competent surveyor, which again discourages the prospector, who cannot always afford it. If a claim is worth patenting, let it be done right, make it permanent, with stone monuments, ensuring permanence. By adopting vertical planes, parallel with the other lines, we do away with all apex litigation and the geological experts, who combine with the attorneys to rob those who do find a valuable mine. Are not most of our laws made for the benefit of the attorneys as a class? About 90% of our legislators are attorneys.

G. L. SHELDON.

Denver, Colorado, July 31.

[We do not agree at all, with the imputation of selfish motives to the mining engineers who helped in the revision of the mining law, however much we may sympathize with the prospectors' lament. The imputation of motives is a poor argument. It recoils. With much of the rest of this letter we agree.—EDITOR.]

The Editor:

Sir—In the revision of the mining laws, Alaska may need something different from the laws covering the States.

I made three trips to Alaska, and spent over seven years in the Klondike and Alaska, prospecting, mining, chopping wood for the mines, cutting and rafting wood and logs, working as a day-laborer in the mines and woods. The first trip was with the big stampede in 1898. In 1900 I went from Dawson to Nome in a row-boat, down the Yukon river and along the coast of Bering Sea. At that time there were a number of transportation and trading companies operating large fleets of steamboats on the Yukon. And along the river, wherever there was a good landing for steamboats, and wherever there was a chance, placer diggings would be found. Trading-post sites covered the best part of the water-front.

At one place on the Bering coast 100 or more tents (all vacant) were set up by one transportation and trading company to hold town-lots; I was told that this same company held 3000 placer locations.

In 1910 I stampeded to a strike on the Iditarod; went down the Yukon on a steamboat; but was sorry I did not go in my own row-boat. On arrival at Whitehorse, I found navigation open to Dawson, and a few steamboats operating. The town was crowded with travelers for down-river points, the dock was crowded with freight, and freight was stored at sidings for miles out. There were a dozen or more steamboats in the shipyard, but none in commission. The company claimed it did not pay to operate them. Travelers had to await their turn in getting passage down the river. Some outfits probably lost a season's work by not getting their machinery in time.

On the lower river there were only two transportation companies operating. One was a consolidation of a num-

ber of companies, and had several good boats in use; the other, the old-timer, had only two small boats in commission, out of a fine large fleet. This is the company that made a specialty of grabbing steamboat-landings, town-sites, and placer claims. They went broke, but still they can't see where they were wrong, as, judging from the tone of the proposed mining law, they still advocate staking by power of attorney and large holdings of mineral land. It is a foolish and short-sighted policy. What use has a transportation and trading company for boats and stores if they keep the people out of the country by grabbing the placer mines? They killed the goose that laid the golden eggs. It was their business to transport the miner and to supply his needs from their stores in exchange for the miner's gold. The transportation and trading companies are the very ones who should want small placer claims, and no power of attorney. Thus there would be more claims and more claim-owners, more gold mined, and more passenger and freight business.

If placer claims were limited to 500 ft. square and no power of attorney given, instead of 3000 claims owned by one company, and only a few men working them, there would have been 8000 claims and as many claim-owners. It seems to be the fault of the company's agent or advisors, who are on or visit the ground. They probably lose their heads at the sight of a good placer clean-up, and by listening to glowing reports of rich strikes. What more do they need than to control the transportation and supply business? Let the individual miner get the gold; the transportation and trading will eventually get more than their share.

In 1910, on my last return from Alaska, I wrote a letter describing conditions there. It was published in the Seattle 'Post Intelligencer' of November 11, 1920. I stated that Alaska needs a new mining code. The locating of mining claims by agent or power of attorney is a great injustice to the prospectors and people of Alaska. They have a very small chance to stake a claim, under the present law: an entire district can be staked by one person as agent for people who have never seen Alaska. A prospector who fails to make a discovery has a slim chance to get in on a stampede, no matter how near he may be to it. When a new district is found, parties start out with their pencils and locate the country for a hundred miles or more. Some creeks have been staked three times by different parties, each giving the creek a different name, and seldom any one of the locators stays to prospect. They wait, and if some stray prospector finds pay, they show up.

At the Klondike, in the Yukon, it was shown that it is not necessary to have large claims, or to stake by power of attorney, in order to get capital to invest in a placer camp. The first years of a placer camp in Alaska are a prospector's proposition, and many a one has made a home-stake of from $5000 to $10,000. There may be as large a deposit of placer gold in Alaska as was found in the Klondike, but under the present system or laws there can never be another Klondike in U. S. territory. A few persons could control the entire district. The large claims on Otter creek in the Iditarod district are let in 300-ft. lays, and the lay-men must operate with heavy machinery. Before the Klondike strike, 500-ft. claims seemed to be the rule on the Yukon in Alaska.

Probably 25 persons control the entire pay-streak in the Iditarod district. If claims were 500 ft. square and each locator staked his own claim there would be 3000 claims and claim-owners on the pay-streak. The more claims and the more claim-owners there are, the more chances an operator has to buy or lease a claim, and the more business for the merchant and transportation companies.

A tax that is so obnoxious, unjust, hard, and expensive to collect as the Alaskan road-tax, should be changed to a miner's license; at one-half the price it would bring more revenue; and those who own the mines would help pay the taxes. As it is now, a man may own the best mine in Alaska and live outside or be exempt on account of age limit or physical condition, and a man working at the mine for so much per day if just under the age-limit must pay road-tax.

Let no person stake or own a claim or an interest in a mining claim who has not first secured a miner's license. The license should include the right to cut cabin logs and wood for his own use, hunting, and fishing in open seasons. There should be a license or registering fee collected from aliens and others, granting them the right to get logs for cabins, and fire-wood, also to permit hunting and fishing.

All placer claims should be the same size, 500 ft. square, no side-line to be more than 500 ft. long. All creek claims should be numbered, side or bench claims to be named. Discovery claim could be staked similar to quartz locations, the location notice to be posted at the discovery or location monument, and should read so many feet up or down stream to centre-end post, and so many feet away from centre-end posts to corner posts, with the number or name of claim, date of location, signed by the locator. All claims should be staked by not less than six stakes or monuments. The centre-end markings shall be the base-line, or supposed centre of the pay-streak or lode, the corner stakes to be placed at supposed right angles to the centre-end posts and marked the N.E., N.W., S.E., S.W. corner, with number or name of claim, and the name of the locator. The side or bench claims should be described as adjoining or lying about so many feet to the right or left limit of creek claim No. —. By numbering the creek claims one can judge the distance to any particular claim.

Don't try to specify the amount of gold a locator must find before locating or recording a claim; it is useless and will cause no end of trouble. The only place it could do any good would be in locating a discovery in a new district. It would put a check on the pencil locator; a clause covering that might help the legitimate prospector.

The discoverers of a new district, from one to three persons in the party, should be allowed four claims each:

two creek and two bench claims, on all streams large or small; all other stakers should be allowed two claims each, one creek and one bench claim. The bench claim need not be staked opposite the creek claim; the creek claim to have prior right over the side claim. If the locator of a creek claim thinks he has not enough room to operate his claim, he has a chance to stake a side claim adjoining his creek claim.

To provide room for the dumping or storing of tailing: this could be taken care of by condemnation proceedings and payment of damage. If the ground is low-grade or barren, the damage would be litttle or nothing. In every district you will find dogs-in-the-manger; so it is well to be prepared to handle them.

By staking claims with six or more stakes almost anybody can survey them; and when looking for a certain claim, if they find a stake with name and bearings, they will know where to look for the others.

By compelling every locator to be on the ground and to stake or help to stake his own claim, it will give more people in the country a chance to get a claim, and more people would stay to develop the ground. If the staker should miss staking the pay-streak he is no worse off than those who arrived there too late to get a claim.

After a locator has prospected his claim and finds it would not pay him to work it, let him relinquish it for a fee, and stake another. He can well afford the fee, as he had a chance at the ground. The fee may be graduated as to the length of time he has held the ground; a quick release within three to six months after locating should command a larger fee than where a claim has been held a year or more. The release will help the old-timer who has used all his rights of locating in the district and can't stake another claim until he makes a relinquishment, and it can be a worked-out claim; the relinquishment should not include those who have sold their claims, until five years after the first location in the district.

It should be unlawful to blanket any mineral land, that is, to stake a claim, when the locator knows he can't legally record it, and is covering the ground for others, who come later, in order that he may get a fee or an interest in the same. A blind location should be null and void, that is, the secreting of a notice of location on the ground and not putting up any noticeable markers, as is done on the desert, by placing a location notice in a can and dropping it on the ground and putting a rock or two upon it. If a prospector finds something of value, they show up and claim prior location.

It may be well not to allow any fraction of a year, the annual assessment work to date from date of location; all assessment work to be of a kind that will develop or prospect the claim; when performed, a notice to that effect should be posted on the claim. The first year's work could be light, where a suitable habitation must be constructed. The building of a cabin and the cutting of wood to apply on assessment work or mining claims in the Klondike proved a failure, as the wood could be sold, and often the cabin was disposed of or was not habitable. The law was changed to a 30-ft. shaft, or its equivalent. There should be no cash payment in lieu of assessment work, as it will not benefit the prospector, who often is on the ground and needs the work.

The granting of a mining concession in a new camp proved to be a failure in the Klondike; Alaska has the same thing in associated claims. Grouping and consolidating can be done after the claims are located, by purchase or the owners consolidating.

Conditions in the Iditarod camp in 1910 convinced many that there is need for better mining laws, and the regulation of transportation to and in the interior of Alaska. A camp within two weeks travel of Seattle, by the lower river route, did not get its third mail for the open season until September 20, and first-class passengers were 42 days on the way from Iditarod to Seattle.

It might be well to increase the size of quartz claims to 1500 ft. square, and not to allow the claimant to follow any mineral beyond the boundaries. They could be staked 100 ft. on one side of the vein, and remainder on the side of the dip of vein, and that would probably cover the vein as far as the owner cared to work it. All mineral claims should be staked, with end or centre-end posts, or markings, as they are supposed to lie on the centre of the pay-streak or strike of vein.

The notice of location should be posted on a monument called the location post or monument. Cut out the discovery monument, as often there is nothing in sight. The notice should read so many feet, for example, upstream or in a northerly direction to a post, the upstream or north-end centre-post if in the centre, and so many feet down-stream or in a southerly direction to end-posts, and number of feet each side of end-posts to the corner-posts or markings. Then all the lines will close when correctly surveyed.

The railroad from Cook's inlet to the Tanana valley will regulate to a certain extent transportation in the interior. I believe a good narrow-gauge system would be more suitable for Alaska, as branch or spur-lines could be built to many of the interior districts. I believe a light narrow-gauge railroad can be built, operated, and maintained cheaper than wagon-roads, which can be used in the summer-time.

W. K. WHITMORE.

Mojave, California, July 20.

The Editor:

Sir—I have read the draft of the revision of the mining law in your issue of June 18. Some parts are all right, but most of it is wrong. It should not become a law, because the capitalists would soon own all the mineral land and the prospector and mine-owner would have to quit. It's as bad as railroad-land grant. Mineral land should have the same protection as agricultural land and all mining claims should be recorded in the U. S. Land Office. That would starve out some of those lawyers and law-breakers. They are the principal cause of the falling off of the prospectors, who are getting tired of being robbed and are quitting. The present Mining Code suits me but it needs a penalty attached to it for

being over-ridden by air-castle locators and title-clouders who are nothing but tools for the lawyers.

During my thirty-two years as a prospector and mine-owner I have known but three cases that went through the courts where the rightful discoverer of a mine got a square deal and that was by means of a Supreme Court decision. I have not known one case of a homesteader that was right but got a square deal. My way of revising the Mining Code is:

1. Tax every mining claim $100 every year instead of assessment work, to be put in a separate fund to be used to develop other mines.

2. Any party staking off mining claims without making a discovery and doing ten feet of a shaft pay a fine of $100 or one year in the 'pen'.

3. That any party staking off more than one claim on any one lead pay a fine or imprisonment as above.

4. That any difficulties arising over mineral on unpatented land be strictly an affair for the U. S. government to settle, and outside the jurisdiction of the court of the county in which it is situated. Then and not until then will the mining industry have the encouragement and protection it so well deserves.

F. J. Kirby.

Etna Mills, California, July 27.

The Editor:

Sir—On noticing in a previous issue of your publication an article on the subject of new mining legislation being prepared by a committee appointed by the U. S. Bureau of Mines, I awaited with interest the publication of the proposed modification of the law.

Since reading the text of the proposed revision as published, I am compelled to believe that, from the passage of the Bill, the prospector and individual miner will cease to exist except perhaps as hirelings for some wealthy mining operator or corporation, and that, while the intent of the Bill is ostensibly to aid and promote mining and prospecting for useful minerals and metals, it is framed so that it will be merely an aid to the omnipresent land-grabber.

Mr. Beardsley's article in your issue of July 30 has much of good common sense in it; and there is, to my mind, no doubt at all, after reading the language of the Bill, that a prospector would have to be accompanied by a geologist, a lawyer, and a surveyor in order to protect his rights to a discovery. Then, too, after he had thus protected them, in five years he would be at the mercy of the financier if he desired to protect his claims beyond that period. True, some will say that if a prospector cannot develop his prospect and get it going in five years it is problematical if he ever could; but, admitting this point, the prospector is certainly entitled to a portion at least of the fruits of his discovery. The Bill, as written, would certainly leave him a shining mark for that class of 'sharpshooters' who infest the mining regions looking for 'cripples'.

We have sufficient examples of the evils of 'location without discovery' in the numerous mining (?) ventures incorporated in certain localities which are based on locations made without discovery and which, after a brief period in which they are manipulated by unscrupulous stockbrokers to the disadvantage of a portion of the credulous and speculatively inclined public, gradually drop to 1 cent, bid, and then disappear from the stock-exchange list.

As a personal experience I might cite an instance that occurred a number of years ago when, after following certain of the Nevada mines for a number of months through the articles appearing in the daily press, I decided that a certain one of them was due to advance, and prepared to share the profit. On the way to the Exchange I met a certain canny and honest Scotchman, who is a mining engineer of the old school and who, fortunately, had but the day before returned from the vicinity of the 'mine' in question. Greetings were exchanged and, as the 18th Amendment had not then been passed, we adjourned to a near-by refectory and the following conversation took place:

Q. "M—— what do you know about the K—— property?"

A. "You have no interest in it, have you?"

Q. "No, but what is the matter with it, why does not the stock advance?"

A. "Well, I'll tell you. That mine is one of a string that I keep track of for some people down here who are speculating. There isn't a pound of ore in sight in it anywhere, and I see no reason to suppose there ever will be. The formation is not right."

This was, of course, enough to keep me from carrying out my intention to buy some of the stock for a rise. A few months later, however, happening to meet the same Scotch engineer at the same place, and having looked over the market quotations for mining stocks but a few moments before, the first question was repeated, and the reply was:

A. "Let's see, you asked me something about that once before didn't you, and you told me you had no interest in it?"

Q. "Yes, but I intended then to buy in on it."

A. "Oh, I see. Well, I would have to tell you now just what I told you then. There isn't a pound of ore in the whole damned mine and I don't see any reason to suppose there ever will be. The formation is not right. They are way off from the ore. But tell me, what price was it then?"

Q. "9 cents bid and 11 cents asked."

A. "Yes? That was a pretty good price for it. What is it now?"

Q. "Heavy sales yesterday at over 90 cents."

After which we took another drink and departed.

Beardsley is right. "Lodes do not conform to section corners. We do not want 40-acre or 160-acre tracts." We do want our "lodes or veins with all dips, spurs, and angles". We want our logical 300 ft. on each side of said lode-line and our 1500 ft. in length. We want the right to possess our 'discovery', and must protest volubly

against any attempt to make location without discovery legal.

It must be admitted that the so-called apex law has been the cause of some litigation, but it is apparent that it cannot have caused litigation to the extent that the new law will when a lode running at an angle crosses 40-acre tracts diagonally, and the adjacent lots on the dip are located by others who sink to strike the orebody and, for some reason or other, as will certainly happen, the various locators get at loggerheads.

The present locator of a claim sequesters but about 20 acres of the public domain. Under the new law he would never think of taking less than 40 acres of our rapidly diminishing open land. Near here, at present, the patents on at least four 40-acre lots of school-land which were purchased from this State at public auction early in 1920 are being held up still, owing to the location of three alleged mining claims approximately in a diagonal direction across the middle of the quarter section. In this case, therefore, in place of segregating 60 acres from the public domain, the three claims would take 160, and, if the one locating them desired to protect himself on the dip of the formation, he would have been obliged to locate, at the very least, four more similar lots.

The present law is based on a logical idea of giving the prospector title to such mineral as he discovers, in areas suitable to his means, and of protecting him in his discovery to the limit of depth below the surface to which the deposit reaches. It is based on sound judgment, good principles, and a logical recognition of the rights of discovery. Let us leave it as it is until we can give at least one real good sound practical reason why it should be altered as proposed or in some other manner. And while we are on the subject of laws, as our Chinese cook remarked a short time ago anent the passage of the Alien Poll Tax Law, "Whassa malla this countlee? Too muchee law. Alla time new law evely day. My countlee gotem same law 4000 years. Evelybody know him. Nobody but bad man blake him. Thisee countly 4000 new law evely year; nobody know him, evelybody blake him. Too muchee law alla time." And, by and large, Chinese philosophy has always been good philosophy.

Did you ever stop to consider the number of Government, State, County, and District officials that one who desires to operate a mine in this State must come into business contact with? The number of National and State Commissions that he is brought into contact with by the present laws and is in a measure responsible to? The number of comparatively unversed individuals who have apparently nothing to do but make new rules for the regulation of this industry is appalling. Many of the regulations in this State for deep mining for metals were taken bodily from Eastern regulations for the mining of coal from blanket veins at comparatively shallow depths.

We Mother Lode miners are mining for gold—the standard of value—the price of which we cannot change, because it is a standard. We are treated in many ways as is the manufacturer who only asks that all manufacturers in his line be compelled to obey the same rules, and then, if the rules increase his cost of production, he knows that his competitors are affected in a like manner and they simply raise prices to suit the new condition. This we miners cannot do. The additional cost of manufacturing is borne by the 'ultimate consumer' and is thus distributed widely and is not felt to any great extent. The cost of production of gold is borne by the producer alone. A raise in power-rates, for an example, may raise the price of cotton cloth a fraction of a cent per yard and net the manufacturer a small additional profit. This same raise in power-rates may put a gold mine out of commission and cause the enormous investment to lie idle and non-productive for years, and perhaps be a total loss. Take some of the larger gold-dredges as an example, working in comparatively low-grade ground. One might make a fair return on the investment with the rates for power pertaining prior to the creation of the Railroad Commission and, with the probable average consumption of 1.5 kw-hours per cubic yard of material excavated, might fail to 'break even' at the present rates for power. And so it goes.

In the desire to eliminate every risk from mining, rules and laws are being promulgated which, like the celebrated 18th Amendment, are being more honored "in the breach than in the observance". Laws that do not coincide with good sense and judgment will always be broken. Laws were not primarily intended to be made for the sole purpose of having something to break and, if we desire to remain law-abiding, we must not proceed to make a superfluity of intricate, annoying, and restraining regulations which hamper business, mining, commerce, and even personal liberty. There is a growing general feeling of pride among the masses in the fact that they are regularly breaking some law in some small way. People that were formerly known as strictly law-abiding citizens are almost boasting of their violations of the 18th Amendment, and the habit of breaking one law leads to the breaking of others, and thence to anarchy.

Let us take as an axiom the statement that in mining it is impossible to eliminate all risk, just as it is impossible to eliminate all risk in crossing Market street on foot. Everyone that lives and works must take risks every day. This does not mean that it is essential that every one take the view that "Life is a gamble and death is a joke", as one writer has put it, but, as each individual must, law or no law, take the risks that are common to his walk in life, be it trade, business, or profession, let us eliminate the vast compilation of hampering rules, rules which our forefathers got along very well without, and see if we cannot make more progress. A ship cannot very well sail at a high rate of speed to some foreign port when it is anchored, and an industry cannot advance when it is hampered by all sorts of petty rules and restrictions 'in restraint of trade'. The cook was right—"too muchee law". This being so evidently the case, let us be sure that we are right before we go ahead with the proposed amendment.

San Francisco, August 8. G. L. Holmes.

Silver and the Pittman Act

By Senator Key Pittman

*I appreciate the opportunity of informally addressing you on the subject of silver, because I feel that if I have any information on the subject which you have not, I should lay it before you. While I have no fear that the so-called Pittman Act will be repealed, I know that there is always a chance of hasty and improper legislation. Because of this chance all those who are interested in maintaining certain legislation should be advised of every fact and of every action relating thereto, so that they may be prepared to lend their aid at the proper time and in the proper direction.

The price of silver was fixed at a dollar because of conditions existing at the time; the Government is in honor bound to maintain that price until the quantity it sold under the Pittman Act has been restored. But, aside from this, the increased quantity of silver that the dollar price makes possible is a matter of sufficient importance to warrant the Government in maintaining this figure. Newspapers have made absurd statements in regard to the Pittman Act. They have used violent language in reference to the passage of the bill, and those articles are bound to have their effect upon persons who are guided by impressions rather than by arguments and facts. These attacks make it necessary for us to discuss frequently, in the most elementary manner, matters that should be of general knowledge.

Lord Reading, when about to leave for India recently, made a public address in which he stated that the action of the United States government in furnishing silver for India in April 1918 was one of the most powerful acts that could have been performed toward the winning of the War. He told his audience that it was essential to have silver in India and to have it immediately; and, astonishing as it might be, there was no surplus supply of silver in the world except in the Treasury of the United States. There was a surplus of gold in many places in the world, but there was not a surplus of silver except the four hundred odd millions of silver dollars lying in the Treasury of the United States as security for silver certificates that had been issued against it. The total production of silver since the beginning of any history is only about sixteen billions of dollars, this including silver that has been produced and utilized for every possible purpose. When we stop to think of the amount of silver lost and destroyed in those three or four hundred years, silver that is secreted never to be found again, just as gold is lost, we realize that the supply of silver in the world is necessarily small. It is possible that the actual existing supply of silver in the world is less than the supply of gold.

The production of silver in the United States in 1881 was about 33,000,000 oz. Production gradually increased to and including 1907 when it reached 56,000,000 oz., an increase of 23,000,000 oz. Yet during all that period strenuous efforts, backed by capital, ability, and energy, were made to open up new bodies of silver ore. In 1908 and 1909 the production of silver in the United States fell to 52,000,000 and 54,000,000 oz., respectively, due to the panic conditions of that period, and the necessary closing down of mines by reason of lack of credit. In 1910 production rose to 57,000,000 oz., and it steadily increased to and during 1916 to 74,000,000 oz.; then it dropped, and has been dropping ever since. In 1917 production was 71,000,000 oz.; in 1919, 56,000,000 oz., which figure is estimated for 1920. It will probably be less on account of the copper situation.

The United States has been producing about one-third of the world's silver production, which has averaged about 174,000,000 oz. per annum, not a very large amount, although it might have been considered at one time a large circulating medium of that kind. We had nearly that much in circulation 20 years ago. In the last 20 years the business of the world has increased probably twenty-fold, but the production of silver has not increased even 50%. In spite of the expansion of business, requiring as it does more currency, there are thousands who still believe that metal money is unessential. We still hear the proponent of the greenback. I can understand how, prior to the War, this theory could have been supported by seductive argument; but in the face of recent history it is impossible for a person successfully to argue that paper, that fiat money, no matter how strongly it may be backed by a government, is security, or is a good pledge to be exchanged for property. When you see the money of a powerful government like Germany going down from 25 cents to 1½ cents in value; when you see a great government like Austria with its money valueless; when you even see a country like France, a victor, and another great country like Great Britain, a victor, with their paper currency depreciated by reason of a lack of confidence, then we realize that human nature is human nature, and that the only thing that the great majority of the world will trust is something that is not only good in one country, but is good for something in any country. There are at least two things which are good for something in every country in the world, no matter how cultivated or how uncivilized; these are gold and silver, and, strange as it may seem, there are many places in the world where gold will not be accepted and

*Abstracted from a report of a speech made before the New York section of the Mining & Metallurgical Society of America.

where silver is demanded. We have approximately three billions of dollars in gold in this country. This does not amount to much; it would not pay much more than our floating debt, yet those three billions of dollars in gold are over twice as much as any other three countries possess, and it gives to us a dominating power. It has the power of paying over and over again our internal debts, thus multiplying its power in effecting business transactions. In the same way the little silver that we have on hand, and the little silver that we place in our Treasury each year, although an insignificant sum in comparison with the business of our nation, possesses a power that enables us to transact business all over the world, and enables us to give priority to our business in South America, Mexico, China, and India.

Why were we particularly interested in India and its demands for silver in 1918? Because our boys were fighting, and one of the absolute essentials of the war was jute bagging. Practically all of the jute bagging came from India, and the Indian producers would not accept gold in payment for it. They were accustomed to take silver. Great Britain spent twenty years in teaching the Indians to accept a silver rupee certificate instead of a silver coin, by having places of redemption handy so that the Indians could get the coin every day if they wanted to. Great Britain had partly gained the confidence of these people and had issued four times as many paper certificates as they had silver in their vaults with which to redeem it. A bank is usually safe in carrying 15% reserve if there is no run on the bank, but there was a run on the redemption agencies. Germany knew these conditions, and sent its propagandists among these people, causing them to lose their confidence in paper money.

Then the British sought for silver. They themselves were astonished that there was little or no free silver in the world. They found that there was only one depository of silver and that was in the United States—four hundred odd millions of silver dollars. In a sense that silver did not belong to the government of the United States, but to the miners and the people who had sold the silver to the Government, and who took in exchange certificates of deposit, redeemable in silver dollars upon presentation. The producers of silver, geologists and engineers, for months prior to the passage of the Pittman bill, had realized that we were threatened with the closing down of our silver mines. They were animated by a desire to continue the production of metals. We were at that time striving to get our Treasury Department to purchase silver, and store it up for future use as subsidiary coin. It was no war measure that they then had in mind. By argument, engineers and producers established beyond doubt that, under the existing costs of mining, $1 an ounce would be a fair price for the Government to pay for silver.

Suddenly the Indian situation developed. I was ready to leave for Chicago to address a body of engineers similar to this, when I received a telephone message from Mr. Baker, the Director of the Mint, asking me to come down to the Treasury Department. I was disinclined to break my engagement until Leffingwell came to the phone, saying, "This is a matter of great importance, affecting the result of the War, and you must come down". I went down. Lord Reading was there, with other foreign representatives in conference with our own financial expert and the Secretary of the Treasury. The facts were laid before us. Lord Reading advised us that we hadn't even a week to delay in the matter, saying, "We have got to have this silver". The Germans on March 18 had started their great drive against the British line, which had its back against the wall. The British did not know where to get more men. A revolution in India would have followed the declaration of the non-convertibility of those certificates into silver, and then an enormous military force would have been required in India. Where were the men to come from? What would have been the result of the German drive of March 18 if that propaganda could have been consummated at the time they expected it to be? Immediately the question of a contract with Great Britain and a contract of our Government with the metal producers was discussed. It had already been demonstrated that a dollar an ounce was a reasonable price to pay for silver under the existing costs. There were only a few questions to answer. One was the price at which the metal would be sold to Great Britain, and it was agreed that this would be $1 an ounce, net. Then we insisted that the Government should pay the American producer $1 an ounce for his silver. The agreement was made. Great Britain was relieved before the law ever went into effect, relying upon the promises of Representatives and Senators, and upon confidence in the patriotism and the honor of Congress. There were few speeches made in Congress on the subject, for it could not be freely discussed in public. Each Senator was informed of the situation. He was told that the Government wished to sell this silver to Great Britain who would pay one dollar an ounce for it, and that the dollar would be used later in buying an ounce of silver to replace that which had been turned over to Great Britain. Various prices were discussed, $1 an ounce being finally agreed on.

There is complaint against the Government of the United States for paying a dollar an ounce to the producer of American silver when silver can be bought in the open market at 60 cents an ounce. The United States government is not the party who is paying the producer $1 an ounce; it is simply turning over the proceeds obtained from the British government. The transaction is not costing the taxpayer one cent. The Government took away the security from the silver certificates and sold it to Great Britain, with the understanding that for each dollar paid to the Government, a dollar would be paid to the producer for an ounce of silver. The Government has lost nothing in making this contribution to the War.

It cannot be considered for one moment that the Senators who solemnly entered into the contract with the Government, who understood what they were doing, who participated in that compromise, are ever going to dishonor themselves and their Government by attempting to

repeal that bill, solely because the Government could gain 10, 15, or 20 cents an ounce by repudiation.

Unless we are going to decide to do without silver, we must do what is reasonable to permit the industry to continue in this country. We are now down to an annual production of 56 million ounces. From 1909 to 1916 we annually coined for subsidiary coins various sums from three million up to eight million ounces. In 1917 we used 29 million ounces for subsidiary coin; in 1918, 25 million; and in 1920, 25 million. Today we are using nearly half the production of this country for subsidiary coin alone, and we must have it for that purpose. All of Europe must have it, and there is but little there now.

Note the trend of silver in Europe. Immediately after the Armistice was signed the price of silver advanced until it reached $1.37 an ounce. That was not due to legislation nor to the Pittman Act, but to the fact that all of the European countries as well as China were at that time denuded of silver, and, still having credit and still receiving gold from the United States, they proceeded to buy silver to supply themselves with subsidiary coin that they had lost during the War. During the War they paid their Indian soldiers in silver. That silver never came to the light of day again, and never will unless the Indians are forced to sell their jewelry, in the form of bullion, to keep from starving. France was in such a condition after the War that she had to pass laws against the hiding of silver coins. Postage stamps were used for change. Stores were compelled to invent tags that they could pass out as change.

When our Government stopped giving credit to the European powers they had nothing with which to buy in the markets of the world. They had no gold that they could spare, no credit, and they could not get credit while they had no one working. They were compelled to melt and sell the silver they had purchased after the Armistice. The price of silver started to drop again, and it kept on dropping until it got down to 52 cents an ounce on March 5, 1921.

There is a tremendous demand for silver in the world today but there is nothing with which to buy it, and there may not be for a year or two. The only thing that has maintained production in this country is the fact that our Government is buying this silver. A letter here from a well-known silver-mine operator tells me that in 1919 it cost his company 83.94 cents an ounce to produce its silver; in 1920 it cost 95.58 cents an ounce. He closes by saying that if this bill is repealed, or if the price is cut down, these mines will have to close.

The Pittman Act will not be repealed. The question is how long will it be operative; 208,000,000 oz. of silver was sold under the bill; 50,000,000 oz. has already been replaced. Our country in 1920 produced 56,000,000 oz. It is estimated that by reason of the closing down of the copper mines we will produce only 30,000,000 oz. in 1921. You can estimate how long it will take to replace the remaining 158,000,000 oz. I am satisfied that this fund will last forever. I am confident that the price of silver will go above a dollar, due to the natural demand of the world. When the world commences to get on its feet again, and commences to work and produce, which will be in the next year or two, and the price of silver goes above $1 an ounce, then the Government will cease to buy, and that fund will remain available until some other cataclysm, or contingency, or conspiracy forces the price of silver down below a dollar in the general market of the world. Then the fund will come into action again, helping the producer of the United States, and also helping the producer of the world. This Act takes out of the market of the world one-third of all the silver produced and it, therefore, has a tendency to bring the level of the world market up to $1 an ounce. I think the law is going to work so well that when it expires, if it ever does expire, the Government will re-enact it, probably with a broader scope. Our Government may take the silver of the world at $1 an ounce and distribute it wherever we deem it to be to our best interest.

THE peace uses of antimony are many, states a U. S. Geological Survey bulletin, but only a few require large quantities of the metal, and although its war-time production amounted to nearly 82,000 metric tons per year, it yet remained a minor metal. Its field of uses, however, exclusive of the abnormal war demand, seems to be gradually widening. Consumption of the metal in 1919 is believed to have been somewhat larger than in prewar years. Metallic antimony unalloyed has few industrial uses. In the form of fine powder, known as iron black, it is used for producing the appearance of polished steel on articles made of papier-mâché or pottery. For these purposes it is precipitated by the action of metallic zinc on an acid solution of antimony salts. Antimony alloys readily with most heavy metals, and the alloy is harder than the two pure metals. Most of these alloys possess the property of slight expansion on solidifying. Type metal is an alloy of antimony, lead, and tin; babbitt, antifriction, or bearing metal is usually an alloy of antimony, tin, and copper. Britannia metal, also known as white metal, is an alloy of antimony, tin, and copper, with some zinc, and rarely, small quantities of other metals. It is used in making cheap domestic tableware, teapots, and spoons. Antimony alloys find minor utilization in battery plates, toys, cable coverings, and siphon tops. Small quantities of antimony enter into certain brasses and aluminum alloys. Lead-antimony alloy, or hard lead, is used in making acid-resisting valves. White antimony oxide, mainly the tetraoxide (Sb_2O_4), is used for making opaque white enamel and other sanitary ware. In this use antimony oxides compete with tin oxide. Antimony oxide, mainly trioxide, is used as a coloring agent in the manufacture of glass, as it is more readily fusible than tetraoxide and does not impart opacity to the glass. Antimony oxides are also used as paint pigments. The red sulphides of antimony are used in vulcanizing and coloring red rubber and also as paint pigments. The natural antimony trisulphide, stibnite, enters into the composition of safety matches or of the compound which is put on the match box.

THE PLAZA AND CATHEDRAL OF ZIMAPAN

Mining Districts Near Zimapan, Hidalgo, Mexico

By Robert B. Brinsmade

Zimapan is a city of about 5000 people; it is situated in a small valley 6000 ft. above sea-level, and is entirely surrounded by ranges of the eastern Sierra Madre. Its population depends mainly for support on the mining and reduction of ores of lead, copper, and silver, as the available water only suffices for the irrigation of a few hundred acres, and the rainfall is too scanty for any natural agriculture beyond such desert products as the *maguey*, the *tuna* cactus, and the goat. The Zimapan mining district really includes, geologically, all the camps in Hidalgo along a lime-porphyry contact extending from Actopan (Fig. 1) on the south in a north-west direction, through Cardonal, Pechuga, Bonanza, Monte, Balcones, Ortiga, and Las Cañas to the Moctezuma river, the eastern boundary of Queretaro. The nearest railway point is Ixmiquilpan, 30 miles to the south, over a poor cart-road—the northern terminus of the branch line running 54 miles north-west from Pachuca and constructed by the Honey family of Mexico City. Supplies are also brought in from Sayula station, on the Nacional railway, at 50 miles to the south-west. Unlike most cities away from the railway, Zimapan and its near-by mines have suffered little from the present revolution, but have been producing metal during most of this troublous period. The worst blow to Zimapan was when the retreating army of President Eulalio Gutierrez, in 1915, sacked some of its mining warehouses and merchants' stocks; but the smaller camps escaped less easily, for nearly every house was burnt, by one army or another, in Cardonal, Pechuga, and Bonanza, and everything portable carried off.

GEOLOGY. The chief local sedimentary rocks are limestone and marl, which have been sharply folded by mountain-forming, and are now inclined in every direction, though commonly the strike is more or less parallel to the main gulches. These sedimentaries have been intruded by plutonic rocks—acid or intermediate in composition and taking the form of laccolites, dikes, and sills. The plutonics being usually softer than the sedimentaries are apt to form the gulch bottoms, while the latter rocks follow the crests. The intrusives are of Tertiary age; and, taken together, may be said to compose a gigantic batholith which has upheaved the Cretaceous sediments from Actopan to the north and north-west far into the State of Queretaro. Wherever the intrusives penetrated rocks favorable to deposition, the contact is marked by orebodies of lead, silver, copper, and gold, especially the first two metals.

The orebodies are generally deposited in the sediments at or near their contact with the intrusive, though they also occur along fissures as quartz veins. The former type takes the form of chimneys or lenses, and varies in type from the contact-metamorphic to the replacement, as will be seen in the description of the different districts. The ore minerals seem to vary partly with the nature of the matrix, partly with local variations in the porphyry, and partly with depth below the surface. The region is semi-arid, so that oxidized ores often extend to con-

siderable depths and secondary enrichment of silver and copper minerals is common.

The Mines of Actopan. This camp lies on the east flank of a mountain range, paralleling the Honey railway, at Santa Rosa, a village about ten miles east of Actopan station. Its orebodies have been developed along a line-porphyry contact, and comprise lenses in the limestone of oxidized lead ores, with some silver. The ores contain up to 40% lead and 1 to 2 kilogrammes of silver per ton, but the lenses are small and scarce, so the mines have been developed but little. The last activity was in 1918 when a few hundred tons of silver-lead ore was shipped to Aguascalientes by the Cia. Real del Monte, which then held the La Cruz mine under lease.

The Mines of Cardonal. This camp seems to have been discovered in the 17th century, and the ruins of a dozen or more old smelters—some of which now show nothing but slag piles to indicate their former existence—which dot the plain below the mines indicate a considerable production. The mines are confined to the Cardonal range—a narrow mountain mass running north for nine miles from the town of Cardonal at its southwest extremity. The town is 12 miles east by wagon-road from Ixmiquilpan, and at 1000 ft. higher altitude; the range in its central peaks rises about 2500 ft. more, to an altitude exceeding 9000 ft. above sea-level. The prevailing sediments have a northerly strike and a subhorizontal dip and are thin marls below and thick-bedded limestones above; they have been intruded and uplifted in the centre of the range by plutonic flows coming from the Sanctuario mountains across the valley, and a half league to the west.

The orebodies are in the blue limestone capping of the range, and the outcrops at the south end are therefore 1500 ft. below those in the central peaks, which occur at 8700 ft. In the north the lead ore is the richest in silver, in the centre it is ferruginous, and in the south it is silicious in composition. The central group of mines has produced considerable quantities of *almagre*, or iron-oxide paint; one mine, the Chilacoyata, shows an outcrop of high-grade hematite.

Nearly all the old mines of the Cardonal range were acquired about 1875 by an enterprising Mexican, Epitacio Barrera, who worked them with great energy till his death a few years ago. He repaired the old Spanish roads, drove the San Vicente adit, 700 m. long, to tap the Central group of mines, and another long adit, the Providencia, in the Northern group. He also constructed the Chalmita smelter, and white- and red-lead works, in a gulch with a small water-power plant to the north-east of the Cardonal range, and the Concepción smelter in the town of Cardonal. In 1917 the Barrera mines were taken under lease by the Cia. Real del Monte of Pachuca, and have been actively explored ever since. A new adit has been driven in the Southern group of mines, where also a new vertical shaft has been sunk for a depth of 150 m. by means of drills supplied by two Chicago Pneumatic company's air-compressors, driven by gas-oil engines. The company exercised its option, and purchased the Barrera mines in November 1920 for ₱150,000; but as yet this district may be considered in the experimental stage as far as mining on a large scale and with machinery is concerned. In fact all operations were suspended in February, for an indefinite period, on account of lack of orebodies of commercial value.

The Mines of La Pechuga and La Bonanza. Leaving the Cardonal range and following the mountains for 15 miles to the north, we reach La Pechuga gulch at 6600 ft. above sea-level; and by descending this gulch three miles to the north and 1000 ft. lower we come to the ancient silver-mining town of La Bonanza. In La Pechuga are the remains of three old lead-smelters, the largest of which ran as late as 1905 on ore from the La Cruz mine near-by, where small chimneys of lead-silver ore, yielding 12 to 15% lead and 600 gm. of silver, lie along a contact of porphyry and blue limestone. At La Bonanza, on the contrary, there is a strong fissure vein, which strikes east for nearly 2 km. from the north-south fault that formed the gulch bottom. The country-rock here is thin-bedded marl, striking north-east and dipping 45° north-west; the vein dips 70° north. Although the Bonanza vein is continuous and is a true fissure with a clearly defined hanging wall, its silver mineralization is sporadic, the greater part of it showing only quartz, calcite, black manganese, and iron oxides. It seems to be only where the main fissure was cut by cross-fissures that valuable orebodies were formed, and this occurred only at three places. The first is the San Judas mine at the west end, in the town of La Bonanza; then, a kilometre to the east, is the Don Martin mine at 8000 ft. altitude, and at the east end of the fissure are the Zapote mine openings in a gulch 1500 ft. lower.

The Don Martin mine is situated at the intersection of three cross-fissures with the main vein, and its workings had reached a depth of 150 m. below the outcrop when it was shut-down in 1910. Near the surface much of the sorted ore contained up to 5 kg. silver per ton, but at the bottom the ore yielded about 700 gm. Being high up on the mountain, the little water the mine made was easily removed by hand-pumps, which raised it to a 200-m. adit, 80 m. above the sump. The contrary was the case, however, with the San Judas mine, whose shaft-collar is only 20 m. above the gulch-bottom. Up to the 'seventies the San Judas water could be handled by two *malacates*, which were turned by mules to raise the cow-hide buckets; but a fissure was then struck—probably communicating with the creek above—and drowned the mine. To unwater the workings a Cornish pump was imported from England, after building a wagon-road over the mountains for 24 miles to connect with the highway at Ixmiquilpan. This pump had 7-in. cast-iron water-columns, and was supplied with steam by a Cornish cylindrical boiler which was consuming about 100 tons of pine wood per week when the mine was shut-down in 1893, owing to the collapse of the price of silver. At this time the vertical two-compartment shaft had reached a depth of 170 m., and was still showing a combined length of 20 m. of ore-shoots in the sump, which averaged

½ m. in width and yielded 2 kg. of silver per ton. An attempt was made to re-open the San Judas in 1908 by an American company that replaced the old machinery by two 80-hp. tubular boilers, sinking-pumps, and a steam-hoist. However, when a depth of 60 m. had been reached operations were abandoned; and, ever since, the mine has remained idle and full of water.

Camps Tributary Directly to Zimapan. As can be seen in Fig. 2, the mines supplying the smelters of Zimapan are within a radius of 12 km. to the north and west of the city, and may be grouped into six camps: the Monte, the Balcones, the Ortiga, the Arcabuz, the Poder de Dios, and the La Cruz.

Monte Camp. This locality is named from the abundant *monte*, or brush, which crowns the hillsides, and is due to its situation on the north side of the range bordering the Zimapan valley, so that it constantly receives

Fig. 1. Zimapan District

moist winds from the Gulf. The ore deposits here have been formed by a porphyry stock intruded into lime beds. The former rock being the softer, has been eroded, and forms Escalera gulch, running downhill to the north; the limestone hills on each side contain the orebodies. The principal mine is the Concordia, which supplies the bulk of the ore for the Hidalgo company's copper smelter in Zimapan. Its ore contains 1.2% copper, 800 gm. of silver, and 4 to 5% lead, with 7% of FeO, 2% of CaO, 12% of Al_2O_3, and 32 to 38% of SiO_2. The ore-shoot is 1 to 4 in. thick and up to 100 m. long. It is now being worked below the gulch-level with the aid of a 20-hp. gasoline-hoist, and is apparently the only true contact deposit of the camp. The others are smaller lenses, lying within fissures in the limestone, and are named San Vicente, Candado, San José, Concepción, Dolores, Rosario, and Chiquihuite. The Dolores ore-lens is 40 m. long and has been worked to 100 m. below the gulch-level, at which depth the sulphide zone is just beginning. The ore in these smaller mines when first broken is low-grade and needs careful and laborious sorting to bring it up to the shipping grade of 10% lead and 800 gm. silver for the lead smelters. For instance for a shipment of 12 tons per month each, the Candado mine occupied six miners and four peons, the Concepción had eight miners and six peons, and the San José had four miners and four peons.

Balcones Camp. This gulch contains the famous Lomo del Toro group whose outcropping lens, discovered in 1632, led to the first operation of a smelter at Zimapan and yielded, before exhaustion, 6000 tons of ore with 20 to 25% lead and 700 gm. of silver per ton. This ancient oxidized-ore stope long ago caved, and now appears on the hillside like a huge quarry. As in the Monte camp, the bottom of the gulch is here an eroded porphyry stock, whose intrusion lifted the original flat sediments into an anticlinal fold; the strata now outcrop in the hills on

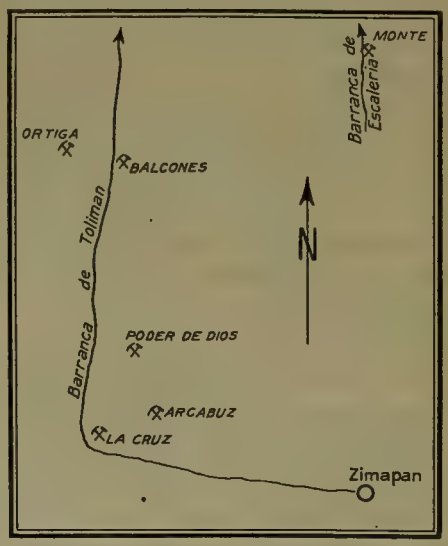


Fig. 2. Mines Supplying Zimapan Smelter

each side as cliffs of thinly-bedded marl. These cliffs are cut by two series of dikes, of the same porphyry as the stock, one following a north-south and the other an east-west direction; both, especially the first, are often accompanied by orebodies. Only the apices of the orebodies, near the surface, have been oxidized; the remainder of them still remain a sulphide-complex that seems similar for all mines of this locality, and ranges in composition between the following extremes:

	1	2
Lead	2 to 5%	7 to 8%
Zinc	3 " 4%	23 " 24%
Iron	18%	25%
Silver per ton	1 to 4 oz.	10 to 12 oz.

The lead of these ores is not in galena but in huascolite, which contains 48.5% lead and 25% zinc; and the zinc is not in sphalerite but in marmotite, with a zinc-iron ratio varying from 5 to 1 up to 2 to 1. Concentration tests made at Denver some years ago yielded a lead head with 45% lead and 10% zinc and a zinc head of 42 to 45% zinc and 12 to 8% iron. The zinc and iron of these heads existed in chemical combination with the lead and zinc, respectively. In the sulphide lenses the peripheral

ore seems to be richer in lead than the core, and the latter was often left intact by the ancients when they extracted the shell.

Although it is reported that 100,000 tons of these sulphide orebodies was developed below the water-level in the Lomo del Toro group before its shut-down in 1892, the greatest accessible orebodies are exposed in the Balcones group of the Zimapan Mining Co., which was promoted, some 20 years ago, by an American named Captain Knocker, with the backing of some New York kings of chicle. The Captain built a two-stack modern lead-smelter before he discovered that he had no ore to feed to it, and was sued for fraud by his backers, who finally won a decision and took over the property. In 1908 a mining engineer named Wrigley was sent to Zimapan by the new owners; by spending $80,000 in development he exposed over 100,000 tons of zinc-lead sulphides of the aforesaid analyses. However, these sulphides were of too low a grade to produce a marketable concentrate without building an expensive mill, so because of the lack of a railway and the growing revolutionary disorders, Mr. Wrigley was recalled and the enterprise was abandoned. Since then the Zimapan company's mines have been worked intermittently by the former superintendent, who treats the ore in a small lead-smelter, the San José, that he has erected in Zimapan.

The Balcones group of mines lies to the north, down the gulch from the Lomo del Toro mine, and at a point on the east side where the gulch bottom lies 520 m. vertically below the summit of the sidewalls—almost perpendicular cliffs that were worked by the ancients, near their tops, for oxidized-lead ores. The mine office is 215 m. above the gulch bottom. A cross-cut adit, 68 m. below the office, cuts the San Rafael ore-shoot at 40 m. and the San Miguel ore-shoot at 130 m. below the outcrop; in each case the thickness is 4 m. with a length of 20 to 40 m. and a composition similar to No. 2 of the aforesaid analyses of sulphides. Both shoots lie along north-south dikes, of silicious porphyry with feldspar inclusions and disseminated pyrite, with some epidote, along the contact. A second cross-cut adit, started in the hillside at 24 m. below the first adit, encountered a cave system and its intersection with an east-west dike, which contained a secondary lens of rich oxidized ore, which yielded ₱40,000 before exhaustion, of the following composition:

Lead	25 to 26%
Zinc	2 " 3%
Iron	8%
Lime	4%
Silica	15%
Sulphur	7 to 8%
Silver	1250 gm.

On the west side of this gulch, near its bottom, and opposite the Balcones group, lies the Carazal mine of the Hidalgo company. This mine is at an altitude low enough to exhibit the transition with depth, from lead to copper ores, that occurs in the Zimapan as in many other base-metal districts. The lenses of this mine lie also along the contact of the limestone with porophyry dikes, and their lower portions have produced considerable quantities of ores, showing chalcopyrite, tetrahedrite, and pyrite, and yielding 3 to 6% copper and ½ to 2 kg. of silver per ton; at present their output is small.

Ortiga Camp. The only productive mines here are the four belonging to the heirs of Marin Yañez, the former prefect of the Zimapan district. These mines are the mainstay of the Purisima custom lead-smelter in Zimapan, and yield 12 tons of sorted ore weekly; a force of 12 miners (double-jacks), assisted by peons for shoveling and hoisting, is maintained. The old workings, over 100 m. below the outcrop, have been tapped recently by a cross-cut adit, whose length, owing to the steepness of the gulch wall, was moderate. The shipping ore is mostly oxidized, and assays 15% lead, 700 gm. of silver, and 4 gm. of gold per ton. These mines were shut-down in 1911, and not re-opened till 1918, owing to litigation. Another mine to the north of the Yañez group had long been famed for rich specimens of stibnite; but a systematic exploration of its ore-shoot in 1915, by a Boston company, proved the stibnite to be only the shell of a lead-zinc lens; the mine was considered hopeless as a source of antimony.

Arcabuz Camp. This *cerro* lies only 5 km. from Zimapan and is therefore the nearest of all the tributary districts. The mines are in a series of low hills, either of limestone or porphyry, and the limestone is intruded by frequent dikes of the porphyry. The chief mine is the Sta. Gorgonia, of the Cia. Minera y Fundidora de Zimapan, which is a sub-vertical fissure vein in limestone. The vein was unpayable, owing to the smallness of the ore-shoot, till the workings had reached a depth of 100 m., where the shoot reached a length of 125 m. and a thickness of 20 to 250 cm., and yielded oxidized ore assaying 15% of lead, 600 to 900 gm. of silver, and 2 to 3 gm. of gold. It contained 17% of iron and 8% of lime, so that it was almost self-fluxing. Although five pairs of miners can break 10 to 12 tons of this ore daily, it takes 70 peons to get it to the surface from the present depth of 360 m., for it must be hoisted through three discontinuous and inclined shafts. Each shaft is operated by a separate hoist; and the ore hoisted from a lower shaft must be carried in a pack or barrow through a drift or cross-cut to reach the bottom of the next shaft above. The highest incline is served by a whim, and is 70 m. deep. The lower shafts are served by windlasses. The other mines on the Arcabuz *cerro* produce similar ore to the Sta. Gorgonia, but their ore-shoots are much shorter and thinner. Among them are the Fortuna, the San Geronimo, the San Pascual, and the Providencia.

Poder de Dios Camp. This is a low *cerro* a kilometre north of the Arcabuz camp. The principal lenses lie along the contact between porphyry and lime, and contain red oxidized ores with 10 to 14% of lead and 500 gm. of silver per ton. The deepest mine is the Poder de Dios, whose camp is 100 m. below the outcrop opening. Other mines here are the Esperanza, Candelaria, San Juan, Noel, and Mario.

La Cruz Camp. This locality has produced some ore

as rich as 10 kg. of silver per ton, but is handicapped by the fact that the chief vein lies at the bottom of a gulch that carries a torrent during the rainy season and floods the mine. The shaft, when it had reached a depth of 68 m. in 1911, could not be longer kept dry, as the silver ore-shoot was too small to pay the expense of pumping. The mining machinery installation cost ₱120,000, and is the only elaborate one in the district. It comprises a charcoal-gas-producer of 130 hp., which feeds a gas-engine driving an electric-generator for supplying current to an electric-hoist, a Sulzer centrifugal sinking-pump, and two Aldrich single-acting piston sinking-pumps.

The Las Cañas Mine. This locality contains only one mine, the Las Cañas, which lies on the hillside just east of the Moctezuma river, at an altitude of 1400 m., and 20 km. west of Zimapan. Its antiquity is evidenced by the remains of a village and a stone church, which cluster around the outcrop and forms a landmark in the surrounding desert. The ore differs from that of the first five of the Zimapan camps in freedom from lead and the fact that its shipping grade often reaches 20 kg. of silver per ton. The country rock is an amorphous blue limestone that has been intruded by a porphyry stock. The ore, however, does not lie on the contact, but in three parallel quartz veinlets about 5 m. apart, which strike perpendicularly into the west slope of the limestone hill and dip 70° to the north.

The ancient stopes have caved and now present a quarry face, 40 m. in height and 30 m. wide. At 45 m. below the base of this face a cross-cut adit was driven into the hill for 150 m. to reach the old workings by an American, named Poole, who re-opened this mine 20 years ago and worked it above the adit-level during three years with a force of 40 men. The venture paid well, when the veins were 10 cm. or more thick; but unfortunately, this seldom occurred; and, as an exploring winze sunk to a depth of 10 m. below the adit floor showed the veins there to be only one or two centimetres thick, Poole decided to stop work. The winze, however, was dry; it would have been better to have sunk 20 m. or so farther before abandonment, in order to demonstrate if the veins had pinched permanently, or were thinned locally, as occurs so commonly in veins in limestone.

Fire Hazards in Metal Mines

*When the use of candles was discontinued in the mine and the carbide lamp substituted, many metal-mine managers drew a sigh of relief, and considered themselves free from danger of underground fires. The occurrence of several serious mine fires during the past year should do much to disturb his equanimity and should make him inspect his mine for fire hazards. These recent fires should start him thinking about fire-proofing, fire-preventing, and fire-fighting methods. He should realize from a study of the causes and effects of these mine fires that the danger of fires in mines is ever present; that fires start easily and unexpectedly; that fires on the surface and underground are hard to control when no arrangements have been made nor thought given to prevention or fighting; that it takes only a small fire to fill the mine with smoke and poisonous gas; that a mine fire often results in loss of life and serious losses of property; that operations are stopped sometimes for months and often for a year or more.

The endeavor to reduce costs to a minimum, coupled with the feeling of immunity from fire, has resulted at various mines in the development of dangerous fire conditions. The following have been observed:

1. Wooden head-frames.
2. Planked floors around the shaft collar or adit portal.
3. One or more frame buildings in the immediate vicinity of the collar of the shaft or adit portal, oftentimes grouped about the collar. At several mines frame buildings have been built over the shafts and adit portal.
4. Mining timbers piled in the immediate vicinity of the collar of the shaft or adit portal.
5. One or more cans of oil and gasoline standing at the collar of the shaft or adit portal.
6. One or more boxes of dynamite near the collar of the shaft or adit portal.
7. Oil, waste, newspapers, and papers from powder boxes thrown under the timbers of the inclined head-frame.
8. An accumulation of waste materials and refuse around collar of shaft or adit portal.
9. Wooden snowsheds leading to the mine portal with boxes thrown under the timbers of the head-frame.
10. Accumulation of oil, waste, and paper, in the incline timber-sets immediately below the shaft collar.
11. Pump-house and hoist underground not fire-proofed; uncovered oil, waste, and cans of lubricating oil in the immediate vicinity of the pumps and hoists.
12. Accumulation of combustible rubbish, dynamite, and mine timbers at underground stations.
13. Electrical equipment not properly insulated and not placed in fire-proof stations.
14. Underground magazines in unclean condition; boxes and papers permitted to accumulate; dynamite in working places.
15. Large carbide containers left open, partly filled with carbide.
16. Pulleys and idlers in shafts permitted to run hot.
17. No attempt made to control ventilation.
18. No fire-extinguishers or fire-hose available.
19. No self-contained oxygen-breathing apparatus.
20. No men trained in the use of the self-contained oxygen-breathing apparatus.
21. No plans made for fire fighting.
22. No disaster signals.
23. No arrangements for converting the air-lines into water-lines to fight fires.
24. No fire doors.
25. No fire-inspection in the stopes.
26. No thought given to fire-proofing the shaft collar, the shaft timbers, and the stations.

*Abstracted from a Bureau of Mines bulletin 'Fire Hazards in Metal Mines', by Byron O. Pickard.

Mineral Industry of South Africa

By Owen Letcher

Introduction. For a number of reasons the present position of the mining industry in South Africa invites attention. Last year the Transvaal contributed over 50% of the gold output of the world; in the absence of the development of any new gold-field of importance the mints of the nations will have to continue to look to the Rand for the maintenance of a supply of the precious metal. Another aspect of importance is the growth of the coal export trade of the Transvaal and Natal. From an American point of view special interest attaches itself to the condition and prospects of the diamond market—the United States being the principal consumer of South African brilliants—and to the entry of American capital into the field of diamond production. Other features of the mineral activities of the sub-continent are the initial development of an iron and steel industry, the growth of the asbestos-producing industry, and the stagnation of copper and tin mining resulting from a serious decline in the prices of these metals.

Gold. For some time past it has been evident to the most casual student of mining on the Witwatersrand that the Main Reef series has passed its zenith of prosperity. The old rich outcrop section of the Central Rand, which under the technical tutelage of Hennen and Sidney Jennings, George E. Webber, and other American engineers made the Rand famous and greatly enriched its financial sponsors in the 'nineties, has ceased to exist. The first row of deep-level mines, with which the name of John Hays Hammond will always be associated, has become almost exhausted over the greater portion of the Central section; and even in some of the others a lack of profitable ore, greatly hastened by the advance in working cost, is imminent.

The principal developments of today are taking place in the eastern annex of the old Central Rand, which lies between Benoni and the Nigel, and is known as the Far East Rand. The growth of production in this district during the last decade has been almost in direct proportion to the decline of output and development in the Central section; and at the present time the 11 producing mines of this area (the New Modderfontein, Modderfontein B, Modderfontein Deep Levels, Modderfontein Government Areas, Modderfontein East, Van Ryn Deep, Van Ryn Estate, New Kleinfontein, Geduld Proprietary, Springs, and Brakpan) are earning nearly three-quarters of the profit of the whole Rand. In addition, the New State Areas mine is forging ahead with a progressive scheme of development, and will commence production within two years. Two other promising enterprises are the West Springs and Daggafontein mines, in which the Anglo-American Corporation of South Africa is interested. Development has so far been attended by poor results. The Daggafontein company has recently suspended operations for the time being. The claim-holdings of these companies, however, are so large and the development carried out has been so little that it is considered probable that the adoption of a more intensive exploratory policy will result in the finding of large blocks of profitable ground. On the Far East Rand the development exposures to date, except in the rich sub-outcrop sections of the Modderfontein mines, have not disclosed more than about 55% of pay-ore. The gold occurs in fairly well-defined shoots of indefinite latitudinal and longitudinal extent; until more driving, raising, and sinking have been carried out, the dimensions of these shoots cannot be determined accurately.

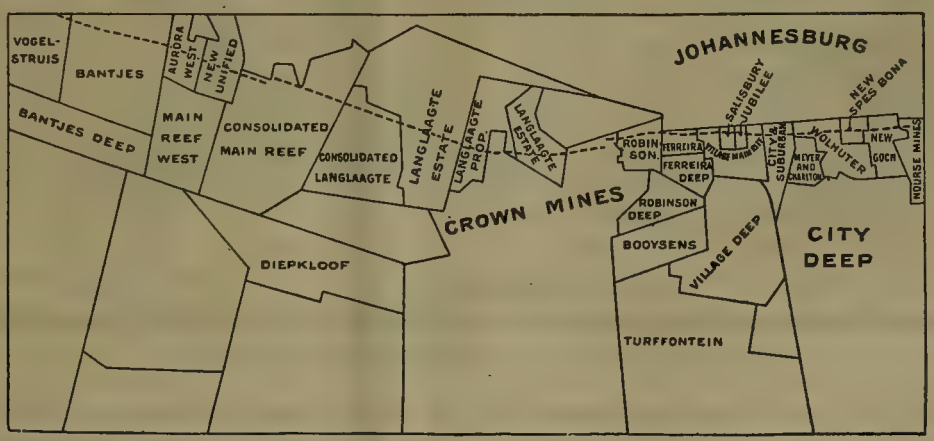
The same evidences of an early exhaustion of profitable ore have been observed in the area lying west of Roodepoort and in the vicinity of the townships of Luipaardsvlei, Witpoortje, and Krugersdorp. Years ago the French Rand, Lancaster, and Lancaster West properties ceased operations, and more recently the Princess and Durban Roodepoort have also done so. The one bright spot in the industrial firmament of the Western Rand is Randfontein. Within the past few years this group of properties, which at one time was the biggest disappointment of the Witwatersrand, was purchased from the Sir Joseph Robinson control by the Johannesburg Consolidated Investment Co., otherwise Barnato Bros. and Solomon B. Joel. Under the management of this enterprising corporation the scheme of development has been re-organized. The numerous old and inefficient shafts are being abandoned, and in their place two new deep-level vertical shafts of large capacity, which have encountered good ore in depth, are coming into use. These will supply the 600-stamp battery—the largest of its kind under one roof in the world. Good development exposures are also recorded on the Horsham-Lindum series of reefs, which overlie the Randfontein orebodies; and it appears probable that within the next year or two the Randfontein properties will earn substantial profits.

The Outlook on the Rand. Although there are sections that promise to maintain output and dividends under conditions less favorable than those obtaining at present, it must be admitted that the condition of affairs on the Rand is unsatisfactory. The gold-mining industry of the southern Transvaal is merely being kept off the rocks of perdition by the trade-winds of the gold premium. The average recovery for the Rand at the present day is about 6½ dwt. per ton; working costs are 26s. per ton milled, so that it is obvious that with gold back at its old standard price of £4.24773 per ounce the Witwatersrand as a whole would be an unprofitable affair. The depreciated value of the British pound in terms of dol-

lars, which determines the amount of the so-called gold premium, has proved the salvation of the low-grade mines; and it is considered that within a few years of the disappearance of the premium only two mines will be producing between Randfontein and the Van Ryn Deep, namely, the Crown Mines and the City Deep. On the present basis of working costs only the richest mines of the Far East Rand (such as the New Modderfontein, tinued increase in the cost of supplies, working expenses rose until they were 40% in advance of pre-war rates. In the middle of 1919 the selling of gold in the open market brought relief to an industry that was almost on the verge of bankruptcy. Unwarranted concessions continued to be made, until, in the early part of this year, the Labor forces attempted to bring about a big demonstration on the eve of the Parliamentary elections, and

Government Areas, Modderfontein B, Modderfontein Deep, and Van Ryn Deep) would be able to continue paying dividends.

Reduction of working costs, which means increased efficiency, is the greatest need of the Rand today. During the War the cost of supplies and wages advanced enormously; and, concurrently with the enlistment of the best class of miners for active service, large numbers of overstepped the mark by causing a series of ill-timed strikes. Since then there has been a much-needed stiffening of policy in the councils of the Transvaal Chamber of Mines, and a campaign for efficiency is being initiated. It is interesting to note that the complex questions relating to what is termed 'selective mining' are being reconsidered; in several quarters it is contended that the Rand mines, and particularly the richer ones, should



the poorer classes of the agricultural community were attracted to the mines. At the urgent request of the Imperial government every effort was made to maintain industrial peace. Large concessions were made in respect of wages and working hours. 'Peace at any price' became the slogan of the industry.

This state of affairs was without justification; it continued after the signing of the Armistice, and it bore disastrous results. Discipline was undermined, a spirit of semi-bolshevism grew apace; and, in the face of a concrush the richest ore they possess while the gold premium is in force, disregarding the maintenance of regular returns.

Coal. One of the outstanding features of the mining industry of South Africa has been the realization of the value of the extensive coal measures of the Union that are concentrated in the mid-eastern section of the country. Until recently the glamor of the goldfields and the glitter of diamonds appear to have blinded people to the potentiality of the coalfields, and to the value to the

country of an important basic industry. The coal measures of the country extend over the greater part of the south-eastern Transvaal, the northern section of the Orange Free State, and northern Natal. Coal is found also in close proximity to the coast in the neighborhood of St. Lucia bay, a shallow land-locked harbor in Zululand.

The coalfields of South Africa are estimated to contain not less than 60,000 million tons of saleable coal. The quality of the bulk of South African coals can hardly be described as first grade. The average calorific value probably does not exceed 12, and much of the material carries high percentage of sulphur and of ash. There are, however, large amounts in the Witbank field of the eastern Transvaal and in Natal, of coal of a quality that compares not unfavorably with Welsh coal, and that found a ready market at Delagoa Bay and Durban during the War and after the Armistice.

During the period of hostilities in Europe, and because of the closure of the Suez Canal, large numbers of ships coaled at the Cape, and at Natal and Portuguese East African ports. Since the conclusion of the War the price to which coal has risen in bolshevist and semi-bolshevist Europe has tended to build up a large market for South African coal, not only in the East but even in several European countries. The Enyati, Bernica, and Buffalo collieries in the Vryheid district of northern Natal have, for instance, secured substantial contracts

THE CONGO REGION AND OTHER PARTS OF WEST-CENTRAL AFRICA

for supplying the French railways; coal from the Witbank district of the Transvaal has been dispatched to Scandinavian ports. A coal trade of considerable dimensions has also been built up between South African ports and South America and Egypt.

In 1915 the coal output of the Union of South Africa was worth £2,142,479 at the pit's mouth, and £3,566,621 in 1919. In 1920, 11,473,452 tons was sold for £4,506,572. The demand for Transvaal and Natal coal at South African ports during 1920 was so great that many new collieries were opened in various parts of the country by financial and mining corporations that hitherto had not

interested themselves in coal mining but had devoted capital and energies to the more speculative and attractive branches of mining concerned with gold and diamonds.

The Central Mining & Investment Corporation (otherwise Eckstein's) and the Johannesburg Consolidated Investment Co. (Barnatos) acquired options over large areas of coalbearing territory in the eastern Transvaal and northern Natal. Extensive boring operations were undertaken, and the Corner House has thereby proved the existence of a large new area on the Wolvehoek farm in the Witbank field. The Barnato interests acquired a number of collieries in Natal and the Transvaal, among which were the Natal Cambrian, Burnside, Central, Bellevue, Carlchew, and Springs coal mines. So great became the public interest in coal that, a few months age, new coal flotations were practically a daily occurrence; every other person one met in the corridors of the Johannesburg Stock Exchange had, in his waistcoat pocket, an option over a coal farm.

The increased business of the collieries, consequent on the unsatisfied demand of the bunkering and exporting trades, brought about the opening up of numerous low-grade collieries; shipment of coal from these properties has, unfortunately, led to several cases of spontaneous combustion in the holds of ships coaling at South African ports. A Government coaling commission has made recommendations with a view to minimizing the possibility of exporting bad coal.

By-Products and Oil-Shale. Little progress has been attained in the South African by-product industry. The Witbank company is manufacturing tar, and the Dundee company is erecting a large by-product plant at its Burnside colliery. The Natal Ammonium Co. has ceased operations. The Royal Dutch-Shell group has secured options over a large area of bituminous shale in the Wakkerstroom area of the Transvaal and in Natal.

Diamonds. The late Cecil John Rhodes is credited with having said that the second largest productive branch of the mineral industry in South Africa—that of winning and marketing gem-stones—is dependent on the vanity of woman, and, as someone else added, the depravity of man. Whether this be true or not, the essential point is that the diamond industry has, during the past year or two, proved itself to be fickle. In 1919 and 1920 it enjoyed a period of unparalleled prosperity. In 1915 the sales of South African diamonds were slightly less than £400,000; in 1919, £11,734,495; last year the aggregate value was £14,762,956. The Great War dealt a severe blow to diamond mining. The big selling syndicate had a large accumulation of stones on hand, and in 1914 the syndicate that controls the sales of diamonds from the De Beers, Premier, and Jagersfontein companies reduced operations (90% of the Union's production) to the minimum. In 1916, however, the industry began to show signs of recuperation. A renewed demand for diamonds (principally from countries whose frontiers were besieged by beliggerents and whose inhabitants desired investment in some form of easily transportable wealth) induced the controllers of the mines to re-commence production on a large scale. The volume of the market continued to increase, and in the period of world-wide extravagance succeeding the Armistice the outputs and sales of South African diamonds rose to record figures. Prices secured for good brilliants of moderately small size advanced to as much as £15 per carat, and the world-wide demand led to the re-opening of numerous abandoned prospects in various parts of the country, and to a rush to the alluvial fields along the banks of the Vaal river. Prospecting parties scoured the veld throughout the Free State and the western portion of the Cape Colony. Discoveries of importance were made in the Postmasburg district, 140 miles to the west of Kimberley, and it is here that one or two new companies and syndicates have recently commenced washing operations.

The condition of the diamond market, which had steadily been improving for four years, reached its crest of buoyancy about May 1920. In that month the first signs of a break in prosperity became noticeable, and in response to the influence of altered conditions in the world's trade the gem-stone market began to disintegrate. The majority of the smaller syndicates collapsed, but the larger mines continued to maintain operations until early in the present year, when, shortly after the arrival of Mr. Solly Joel (the leading diamond magnate), there was a wholesale dismissal of employees and a curtailment of operations.

The depression in the diamond market led to great distress, and many mines were closed down. Although the slump in diamonds was due to general trade stagnation, it is believed that the threat of competition to the selling operations of the great diamond syndicate (made by the newly formed Consolidated Diamond Mines of South-West Africa by the Congo Diamond Filds and by the River Diggers) induced the financiers who control the sensitive market for gem-stones to announce that diamonds had become almost unsaleable.

The Consolidated Diamond Mines of South-West Africa has been floated under the auspices of the Anglo-American corporation, and controls the bulk of the alluvial areas of the South-West African Protectorate (formerly German South-West Africa). The diamantiferous alluvials of the Kasai River basin in the south-western portion of the Congo Free State and northern Angola cover 8000 square miles, and in 1920 produced 250,000 carats. These fields, which have great productive potentialities, are controlled by the Forminiere company, in which Thomas F. Ryan holds a large interest. The fact that American capital is represented on a large scale in both the Congo and South-West African fields has given rise to a belief that a combination of these two productive areas, backed by New York millionaires, may threaten the supremacy of the diamond syndicate; one rumor is to the effect that the 'Solly' Joel is already negotiating terms with the American interests for the future disposal of the product of Africa's expanding

diamond fields. The outlook is at present obscure, but the view is held that the present curtailment of output, coupled with an improvement in world-trade conditions, will lead to a revival in the market for brilliants.

Other Minerals. The decline in the value of tin and copper has led to a depression in base-metal mining. In 1915 the Union's production of minerals other than gold, coal, and diamonds was £2,349,625. By 1919 it had dropped to £904,520, and last year it was worth slightly over £1,000,000.

The three leading cassiterite producers of the country (Zaaiplaats, Leeuwpoort, and Rooiberg) have recently curtailed operations considerably; in the absence of any new developments of promise, the outlook for these ventures can scarcely be considered as satisfactory. In the South-West African Protectorate some promising deposits of alluvial and lode tinstone have been developed in the vicinity of the Erongo mountain in the Karibib and Omaruru districts. The Central Mining & Investment Corporation has recently secured a substantial interest in the Kohero mine. In regard to copper mining there have been no new discoveries, and the decline in the price of metal led to the closing down of the Namaqualand and Messina mines.

Asbestos production in the Transvaal and Cape Colony is on the increase, and substantial amounts are being marketed in America. The old Pretoria silver-lead mines are being re-opened, and several argentiferous galena deposits are being exploited in various parts of the Transvaal. A new nickel mineral is being mined in the Barberton district of the eastern Transvaal.

Iron and Steel. Great importance attaches to the establishment of iron and steel foundries in the Union. For the past eight years the Union Steel company at Vereeniging has been using scrap-iron, and has been supplying the railways and mines with large quantities of rails and sleepers, as well as heavier castings. The Newcastle Iron & Steel is now completing the erection of a blast-furnace in northern Natal, and will produce large quantities of pig-iron in the near future. The Iron & Steel Corporation of South Africa has been floated to establish a large iron and steel industry on the Pretoria Town Lands, but has not so far secured the substantial sum of capital required to put the venture on a sound basis.

The value of the mineral production in South Africa and its mandatary annex, the South-West Protectorate, to date has been about £900,000,000, and the known resources of the Union are estimated to contain minerals of a substantially larger value than this figure. For the time being the mining industry is under a cloud and is suffering from the effects of world-wide depression and trade stagnation. It is, however, a fair presumption that, with any recovery in financial and trade conditions generally, South African mining will again forge ahead. Certainly few countries offer more attractions to capital; taxation is light and there is an abundant supply of cheap labor.

Russian Gold Exports

The attitude of the United Kingdom toward shipments of Russian gold from England to the United States, as affected by the recent decision of the British court in the gold-test case, is described in a cable from George Harvey, U. S. ambassador at London, in which he said that the London Board of Trade now takes the ground that the outcome of the test case demonstrates that no holder of Imperial Russian securities can successfully contest the Soviet claim to legal ownership of the Russian gold-reserve; and it is stated that the Bank of England will henceforth grant export licenses, on documents of title, for Soviet gold without regard to the character of the assay marks it carries.

In further elucidation of the court decision referred to, the following report from Trade Commissioner W. J. Page, of London, is of interest: A test action brought to decide whether gold rubles, forming part of the gold-reserve of the late Imperial Russian government and now brought to Great Britain by the agent of the Soviet government, were attachable in respect of obligations of former Russian governments, was decided by Mr. Justice Peterson.

The matter came up in an action by Arthur Grotjan Marshall, of Cheam, against Mary Grinbaum, of Bond Street, for a declaration that 7500 gold rubles deposited with the Bank of England for safe custody were charged in favor of the holders of 5% Russian State bonds of 1906. Had Mr. Justice Peterson decided that they were, the Soviet government would have had the right to cancel the Anglo-Russian trade agreement. Mr. Justice Peterson, however, dismissed the action with costs. Giving his judgment, he said that the defendant admitted that the rubles formed part of the gold-reserve of the Imperial Russian government, and that they were brought into this country by her as agent for the Soviet government. The plaintiff claimed that the gold-reserve of the Imperial Russian government was, by ukase dated August 1897, mortgaged to the holders of Russian notes. That contention did not seem to be well founded. The object of the ukase was to make the notes convertible. Apart from that, if any charges were created by the ukase of 1897, it was suspended in 1914 when, in view of the circumstances created by the War, the right to exchange notes for gold was suspended by another ukase.

The methods adopted by the Soviet Russian government to render its gold-reserves bearing the stamp of the old Russian government acceptable in other countries, prior to the foregoing decision, is described by a correspondent of the 'Daily Telegraph', a transcript of which reads as follows: The Stockholm mint has in the first five months of this year [1921] melted down 70 tons of Russian gold, as against 19 tons for the whole of 1920. The gold thus treated was supplied by the bolsheviki, and consisted of bullion and of ingots marked with the Russian eagle. The gold melted by the Stockholm mint is cast into blocks bearing the Swedish hall mark, which makes it acceptable in the United States and other countries.

CURRENT COPPER CONSUMPTION

The industrial depression that since late last year became so pronounced is finding graphic reflection in current consumption of copper. It is close to three years since the Armistice; only on one or two occasions has a conspicuous buying movement appeared in copper. The metal recently broke through 12c. per pound, the lowest since 1915; surplus is still top-heavy and notwithstanding production has stopped, with the exception of six or eight of the smaller mines, the price shows little tendency to advance, says a writer for the 'Boston News Bureau'.

The automotive industries are now consuming at the rate of 54,000,000 lb. for 1921, against 99,300,000 lb. actually consumed in 1920. The electrical industry is 80,000,000 lb. behind last year; the telephone and telegraph 15,000,000 lb. behind. The following table shows the estimated current consumption of American copper by the leading industries of this country, including metal shipped abroad in finished form:

Consumption for:	1921	1920
Electrical manufactures	260,000,000	340,000,000
Telephones and telegraphs	85,000,000	100,000,000
Wire not included elsewhere	110,000,000	190,000,000
Automotive industries	54,000,000	99,300,000
Railway locomotives and cars	14,000,000	17,600,000
Shipbuilding	24,000,000	71,500,000
Buildings	40,000,000	53,400,000
Ammunition	14,000,000	23,400,000
Bearing metal for steam railways	40,000,000	45,000,000
Other uses	100,000,000	197,200,000
Exports of copper manufactures	64,000,000	164,000,000
Total	805,000,000	1,301,800,000

In shipbuilding, locomotive, and car-building, the consumption of copper at present is at a low ebb. But with the rolling-stock of American railroads in a sad state of repair and with an imperative demand for new equipment, it is quite probable this industry will increase its copper takings within the not distant future. The other lines of consumption will more nearly conform to the rise and fall in general business.

J. P. CHANNING AND W. A. PAINE DISCUSS COPPER OUTLOOK

Hope for a great improvement in the copper industry within six months was expressed last week by J. Parke Channing, president of the Seneca Copper Corporation, who recently visited the mines at Calumet to inspect the property. Accompanying Mr. Channing were Thomas F. Cole, director, and E. J. MacNamara, secretary. Mr. Channing asserts that a better feeling toward the coppers prevails.

"Curtailment, the only remedy that could revive the industry, is showing its effects," said Mr. Channing. From a normal output in the United States of about 100,000,000 lb. per month, the curtailment process has reduced the production to 18,000,000. The surplus is being reduced gradually, but consumers will suddenly awaken to the fact that not more than six months output is on hand. Ordinarily 400,000,000 lb. of copper is in process, from the mouth of the mine to the docks in the form of refined copper, and it is obvious that a shortage of copper is bound to come with any quickening of purchases. There may be no great increase in the volume of domestic business within six months, but possibly by that time Europe will be in a position to take our copper, both what it needs for ordinary purposes of manufacture and for replacement. The domestic demand is slowly improving and perhaps some people are impatient over what they term slow recovery. We must realize that we cannot get as quick a reaction as in the past but it is on its way. We also must remember that the United States is self-supporting, self-contained, and can get along without foreign countries. Accordingly we will be back sooner than Europe and meantime great stocks of commodities must go abroad to help the old world rehabilitate."

William A Paine, president of the Copper Range company, after a recent visit, said: "One must not lose faith. Copper always has been a necessity in industry and will continue to be. Copper must and will come back, stronger than ever." Mr. Paine would venture no opinion as to whether or not there will be a general resumption of mining operations this year. He commented, however, on the fact that the biggest producers of copper discontinued output to remedy the dislocation between supply and demand, and that June was practically the first month in which the effect of the mine shut-down was noticeable to any extent so far as decrease in production of refined metal is concerned; no improvement has yet been shown in demand. On the other hand, it will take at least four months, after the mines resume, to bring refinery production up to normal figures. Copper consumption, Mr. Paine believes, largely depends on the return of general prosperity. Approximately 70% of the business now being done by the rolling-mills is with the automobile industry, which goes to show the extent of the depression in other industries which normally use large amounts of copper.

NEW SHAFT-SINKING RECORD

A new world's record has been established at Eureka, Utah, for shaft-sinking by the Walter Fitch Jr. Co., shaft and mine-tunnel contractors. The Water Lily shaft, on the property of the Chief Consolidated Mining Co., was sunk 427.5 ft. in the 31-day period from July 15 to August 15, or an average of 13.8 ft. per day. The shaft has three compartments, the outside dimensions of which are 5 ft. 9 in. by 15 ft. 6 in. Two compartments will be used for hoisting ore and taking supplies into the mine, and the third for air and ventilating pipes, and as a manway. The shaft is timbered with 8 by 8 material, and the inside dimensions of each compartment are 4 ft. 4 in. by 4 ft. 6 in. Three shifts were worked, under the supervision of J. D. Matheson and H. W. Jarvis. Most of the timbering was done on the day and afternoon shifts. An average of 2.8 sets of shaft timbers were placed per day by an average of 4.8 timbermen, and this work was carried on simultaneously with the drilling and shoveling. An average of 72.5 buckets of rock per shift was hoisted. The hoisting was done in two compartments, with buckets of 17 cu. ft. capacity. The buckets were dumped by automatic dumpers, devised by the company's employees, so that the time of dumping was reduced to 15 sec. per car. It was necessary to drill 23.9 holes each round, and there were three rounds per day. An average of 15¼ lb. of 35% gelatine powder was used per foot. The surface equipment consisted of two

small hoists and two compressors, while underground, standard equipment, consisting of Ingersoll-Rand Jackhamer drills, the Sullivan DB-33 drill, and the Denver Rock Clipper, was used. The first 367 ft. of the shaft passed through porphyry, which was good material for shoveling but difficult to drill, on account of stickiness. About 50 ft. of the porphyry had a tendency to 'slab' off before timber was in place. The last 60 ft. passed through what is known locally as 'white lime shale', which is a moderately hard close-grained limestone. During the 31-day period but 13 hours was lost on account of repairs and power failures. The crew employed on the work consisted of 18 machine-men, 4 to 6 timber-men, 6 top-men, 6 hoist-men, 3 shift-bosses, and a general foreman. In addition to their regular wages, the shift-bosses, machine-men, and timber-men received a bonus of $120 each, and the hoist- and top-men, $60 each. Sinking of the Water Lily shaft is being continued at practically the same rate as obtained during the record-breaking period. A photograph of the men who did the work is reproduced on the opposite page.

CONSOLIDATED COPPERMINES DEFAULTS PAYMENT OF INTEREST

The announcement has been made by the management of the Consolidated Coppermines Co. that it has been unable to meet the interest coupons due on August 1, and asks the indulgence of the holders until the company can be re-financed. The company has been a heavy borrower for many years, but during the War it produced; hence shareholders were generally of the opinion that the management would be able to take care of the interest account of its indebtedness without further borrowing. During the early part of the year the company offered a bonding issue to shareholders through which it expected to raise $5,000,000 to be used in retiring all outstanding bonds and provide the means necessary to building a modern milling plant. But owing to depressed conditions it appears that the management was not successful in placing the new issue, hence it is now facing conditions which will require immediate financing to a limited extent in order to take care of its interest charges.

SOUTH AFRICAN MINERS' STRIKE AVERTED

An agreement has been reached as a result of which a strike by the South African miners has been averted, according to a Consular report. Under date of August 9, Trade Commissioner P. J. Stevenson, of Johannesburg, cabled the Bureau of Foreign and Domestic Commerce that the miners have agreed to accept a reduction of 1s.6d. per shift. This arrangement will obtain until October 1, when wages will be adjusted by quarters, the basis for the wages for any period being the cost of living for the quarter preceding. Mr. Stevenson states in his cablegram that South African business interests are well pleased with the settlement, believing that it will not merely stabilize the mining industry but will have great weight in stabilizing wages in other industries as well.

The demand for reduction in the wages paid to those working in and about the mines followed the decrease in the selling price of gold, the gold mines being the ones principally affected. At the suggestion of the Chamber of Mines a reduction of 3s. per shift was considered, amounting to a weekly reduction of 18s. The trade-union representatives claimed that the proposed reduction could not be justified. A compromise has now been effected as outlined above.

CALIFORNIA

Grass Valley.—Production at the Empire mine is again approximating $90,000 per month. The 80-stamp mill is operating at capacity. Ore of excellent grade is reported below the 4000-ft. level with the vein-system showing persistence as explorations extend into new territory. From present indications the Empire will finish the year as the second leading gold mine of California, surpassed only by the Carson Hill group of Calaveras county.

Randsburg.—J. M. Fox, superintendent for the California Rand Silver, Inc., reports that the ore-pocket at the 11th level is completed. On the 9th level, main shaft, shrinkage stoping is in progress, yielding good shipping ore. No. 2 shaft was sunk 17 ft., making the total depth 262 ft. The necessary excavations for mill construction have been completed and concrete work is now in progress. The balance of the steel for the four water-storage tanks has been received. These will have a combined capacity of 400,000 gal. The order has been placed for a new compressor having a capacity of 1302 cu. ft. of free air per minute. On its arrival it will be installed at the No. 2 shaft where, eventually, the main mine plant will be situated. Production of shipping ore was maintained at the rate of 10 cars per week or about 440 tons. There are now being employed from 140 to 150 men.

The Coyote company, at 70 ft. from the shaft on the 500-ft. level, has three feet of high-grade shipping ore. The management will do extensive underground development before mining any of the ore. In cross-cutting they are now advancing 24 ft. per day.

Thirty stamps are now dropping on screened ore from the old glory-hole of the Yellow Aster.

Redding.—The Washington mine near French Gulch, which has been operated by G. E. C. Rousseau for ten months, has had to shut-down owing to the shortage of water. He reports that he did well and will resume work as soon as the water-supply is replenished by winter rains.

Sonora.—The rim of an ancient gravel channel has been entered by the tunnel at the Monarch mine, near Confidence. The deposit averages 10 ft. in thickness and indications are good. Sinking on the rim has begun with the object of developing the main channel at considerable depth.

Sutter Creek.—The Central Eureka company has completed the construction of its pumping station on the 3900-ft. level. The shaft will be continued for several hundred feet before lateral work is commenced.——The mill at the Argonaut mine is running at capacity on ore being taken from the lower levels. Particularly good ore is exposed on the 4900-ft. level.

COLORADO

Aspen.—The first carload of ore from the Hope tunnel, after deduction of freight and treatment charges, netted the company $1288. Two other cars of the high-grade ore await shipment. The new boarding-house is completed and additional miners are to be employed. The tunnel is now being extended.

Cripple Creek.—Discoveries are reported from the Gold Hill section, on the Mary McKinney, Rittenhouse, and Lexington properties on the southern slope of the hill. Ore averaging one ounce gold per ton has been opened for 50 to 100 ft. by lessees.——The United Gold Mines Co. has taken over the Hardwood mine of the Damon group and is operating it on company account. The initial shipment has been sent to the Golden Cycle mill.——Diamond-drill prospecting continues at the Cresson and new orebodies are reported. Heavy shipments continue.——The Gold Bond, on the south-western slope of Gold hill, is again shipping. Miss Mollie O'Bryan and associates are in receipt of returns on their first carload shipment. Settlement was made at the rate of $19.60 per ton.——Sam MacDonald, pioneer mining man and former superintendent of the El Paso Gold King, is extending the Sangre de Cristo tunnel into Tenderfoot hill. He is saving medium-grade ore. The tunnel heading

is in Black Diamond territory, a former producer controlled by the Lennox-Giddings interests.

Georgetown.—Ore sampling 5.2 oz. gold and 4 oz. silver has been opened on the Nancy Smith claim by Dave Kennedy. The property has lain idle for 48 years; it was patented in 1873. The vein is 5 ft. wide with the hanging-wall streak sampling 3.6 oz. gold and 3.4 oz. silver. The vein is pronounced the extension of the Centennial-Capitol veins; the Nancy Smith lies between these two former rich producers.

Idaho Springs.—The Utah Colorado Mining & Milling Co. has commenced development of its Bertha group of 17 claims, situated between the Frontenac and Sun & Moon mines, in Pleasant valley.——The tramway of the Roosevelt company at Alice is nearing completion and the mill will be operating on a 24-hour basis by the end of the month. Large reserves of ore have been developed.

Ouray.—The Mountain Top Mining Co. is installing a Hardinge mill and doubling the capacity of its plant. Development of the Agnes vein continues to be favorable.—— The Hidden Treasure operating force has been increased to 25 men, the largest number employed to date. Development continues and ore-reserves are being steadily increased.

Silverton.—The Neuville group has been leased to local men who will mine ore from the extension of the rich Yankee Girl vein already exposed and being developed.—— Operations have been resumed by the North Star Leasing Co. on the Gladstone. A large tonnage of mill ore is broken.

Telluride.—The Liberty Bell is making its last clean-up preparatory to the final shut-down. It is estimated that the mine and mill have produced in excess of $10,000,000. The mine and mill machinery it is expected will be sold.

IDAHO

Coeur d'Alene.—At the portal of a new cross-cut tunnel on the property of the Majestic Mining Co., in the Coeur d'Alene, a new vein was discovered. Assays show lead and silver. It is said to have the appearance of developing into a favorable orebody. The property is 1½ miles north-east of Burke.

The Lookout Mountain property on Pine creek, in the Coeur d'Alene, will have machine-drills in operation soon. Several engineers visited the property and expressed favorable opinions. Assays on sample of the ore show 25 oz. silver, 73% lead, and 12% copper.

In the No. 2 tunnel of the Torina Mining Co.'s property, near Mullan, the vein has been followed 75 ft., showing strong mineralization the entire distance, with occasional showings of a good grade of galena ore.——The Sunshine Mining Co., in the Coeur d'Alene, will start operations at once. The property consists of the Yankee Boy and the Yankee Girl mines, which the company has under lease and bond. They are in the Big Creek district, six miles from the Bunker Hill smelter. E. C. Tousley, of Spokane, is manager. The mill will be of 50-ton daily capacity.

The Men Who Sank a Three-Compartment Shaft 427.5 ft. in 31 Days, for the Walter Fitch Jr. Company

Workmen making the raise from the 400 to the 200-ft. level in the Chicago-Boston mine in the Coeur d'Alene have broken through into the 200-ft. level. When within 25 ft. of the 200-ft. level they cross-cut to the vein and found what they believe is the end of the ore-shoot they have been seeking.

KANSAS

Columbus.—Victor Rakowsky, of Joplin, and O. M. Bilharz, of Baxter Springs, are securing new leases of ore lands in this district and also are purchasing fees of lands. The past few days has seen marked activity in the matter of securing leases on lands east of this city, and a number of other prospectors besides the two mentioned are said to be acquiring additional tracts.

MICHIGAN

Houghton.—The only copper to be shipped out of the Lake district in two weeks was 600,000 lb., by boat on August 5, from the Calumet & Hecla, Copper Range, and Quincy smelters. Half of it was C. & H. metal, made up of

200,000 lb. of small cakes for a Detroit concern and 100,000 lb. of billets for France. Calumet & Hecla has no orders on its books at present, but will continue to keep two furnaces in operation. There are still a considerable number of cupola blocks to smelt, and these will be made up into anodes for the electrolytic plant, being returned as cathodes and held in readiness for smelting into such shapes as may be ordered. C. & H. still has a large amount of mass copper and some mineral at the smelter; this, with the cathodes, will permit filling of orders for special shapes without the necessity of re-casting stock shapes. Recent orders have been comparatively small, and it is believed little difficulty will be experienced in handling all business, under present market conditions, with the two furnaces.

There will be no resumption of mining by Calumet & Hecla and its subsidiaries until there is a marked improvement in the metal market, it is authoritatively stated. There has been some talk of a re-opening of the mines as an emergency or relief measure, but no step of the kind is contemplated.

If the State Board of Equilization adopts the suggestion of the State Tax Commission in fixing the equalized values of the counties of the State, the mining companies will pay considerably less in State taxes this year. The Tax Commission has recommended that about two billion dollars be added to the State's equalized valuation; it has been recommended that Houghton's valuation be reduced from $99,000,000 to $90,000,000. If the commission's estimate be adopted, Houghton county's tax rate will be 0.01343 instead of 0.02208 as at present.

MISSOURI

Joplin.—No change was registered in the Tri-State zinc and lead field for the week ending August 6. Zinc ore remained steady at $21 per ton and lead at $50. There were rumors that only $21 was being paid for zinc, and $51 to $51.50 for lead, but these could not be confirmed. A week ago one buyer attempted to get ore at $20, but found it impossible. Demand was not so good, and only 3600 tons was reported purchased. The slab-zinc market continues dull, with no change, national or international, worthy of note. Some slight improvement in galvanizing demand was reported. The sales in the district were reported as follows: Oklahoma: blende 5,561,400 lb., value $53,380; lead 1,508,920 lb., value $37,700. Kansas: blende 2,780,350 lb., value $29,190; lead 227,900 lb., value $5600. Missouri: blende 1,422,520 lb., value $14,931. The total sales for the district were: blende 9,764,270 lb., value $102,521; lead 1,736,820 lb., value $43,300. Total value for the week, $140,801.——The Joplin Iron & Metal Co. is making plans for the construction of a $10,000 store-house. The company suffered a loss of $25,000 by a fire that recently swept a section of its yards.

MONTANA

Butte.—Butte & Superior is putting its mine in such shape that it can get the most out of the zinc market when quotations again permit mining. It has to date developed ore-reserves amounting to over 462,000 tons, an increase of approximately 40,000 tons over reserves at the close of December 1920. This product will average around 15% zinc and between 5 and 6 oz. of silver per ton. Cross-cutting of the copper vein in the Black Rock mine early this year is now overdue, and the impression in mining circles is that the vein has faulted and possibly in consequence the cross-cut has missed the ore. This will be definitely determined as more work is done. The copper vein was found to be faulted on the 2050-ft. level, where it was originally found, and the possibility is that the vein has flattened. Financially, the company is in good shape to weather a period of idleness. It has between $2,500,000 and $3,000,000 in quick assets and its expenses have been reduced to a minimum. Nothing of importance has occurred recently in the litigation with Minerals Separation company. The amount of damages to be paid under Supreme Court decree is being threshed out by accountants under the guidance of Judge Bourquin of the Montana District Court. The mass of figures and details surrounding this accounting confirms the belief of both parties that it will be a long time before the final sum is agreed upon.

NEVADA

Candelaria.—Construction of a 200-ton mill is to be started soon by the Candelaria Silver Mines Co. C. D. Kaeding is managing engineer. His recent report gives an estimate of $3,546,000 gross above the 200-ft. level, mine ore averaging 14 oz. silver and $1 gold, with dumps and fills 9.7 oz. silver per ton.

Cortez.—The lower tunnel of the Cortez Silver Mines Co., known as the Arctic tunnel, nearly 2500 ft. long, has penetrated the porphyry dike that cuts nearly vertically through the limestone and quartzite of Tenabo mountain, and a raise has been started to connect with the old Garrison tunnel, 360 ft. above. The upper adit workings produced over $15,000,000 many years ago, when the mine was owned by George Hearst and Simeon Wenban. The bonanza ore-chambers were opened in secondary fractures in the limestone, branching from the main dike. Unexplored blocks of large extent above the upper tunnel level are to be prospected.

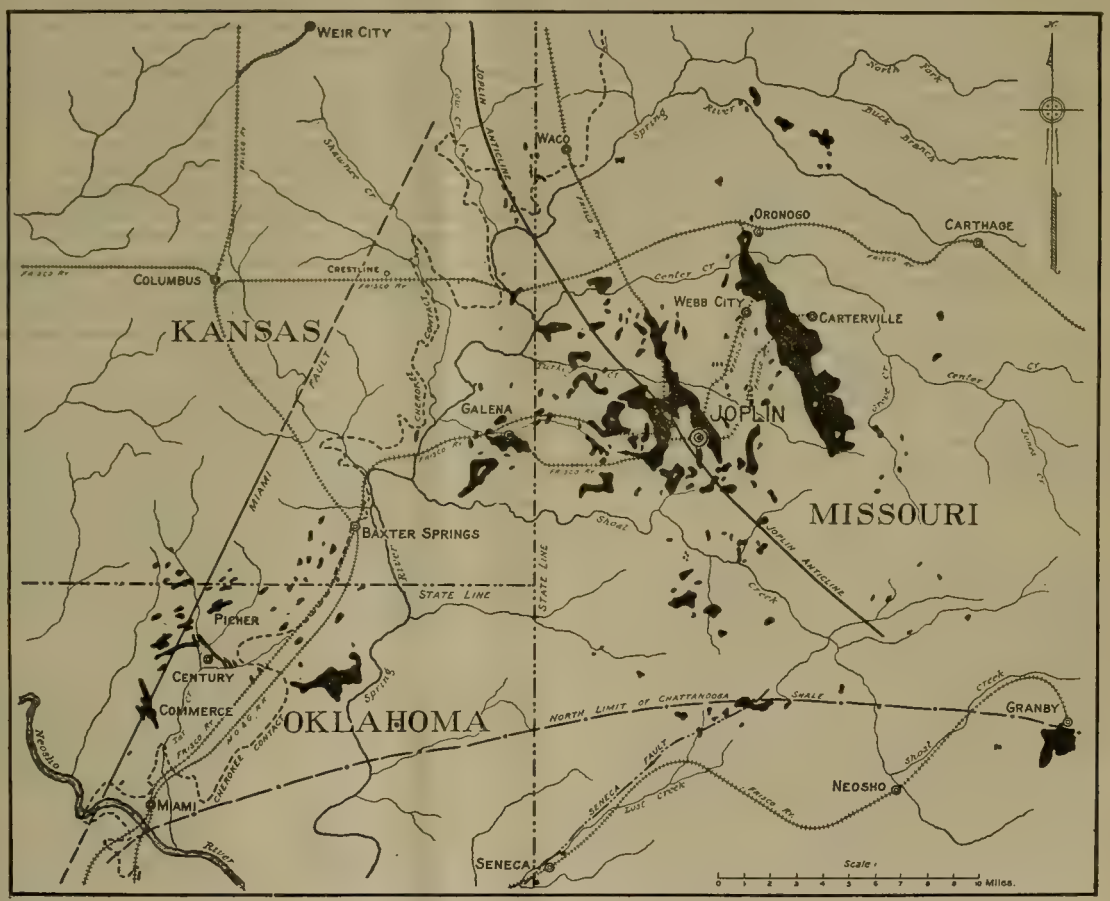
Divide.—The Divide Extension has issued a statement saying: "This company has recently developed an orebody on the 100 and 200-ft. levels with five raises about 40 ft. apart. The ore from these raises has been milled by the MacNamara mill at Tonopah and the result was as follows: 495 tons averaging $83.55 per ton, with a gross value of $41,373. No stoping has been done in this ore, but we will start on the first of September. The extent in length or depth of this orebody has not yet been determined."——The Brougher has resumed work.

Goldfield.—The shaft of the Deep Mines was 875 ft. deep on August 22. No progress in sinking was made during the first week in this month, because of the necessity for relieving and replacing timbers. The shaft is now being sunk at the normal rate of 5 ft. daily, which should bring it to the 1000-ft. point about Septmber 15. It is expected that the C. O. D. vein will be cut at about 1000 ft. The company is in good financial condition, with enough money in the treasury to sink the shaft to 1000 ft., pay for the timber that will be used from the 1000 to the 1500, and still have surplus funds with which to continue the work while assessment No. 3 is being collected. Sinking to date has cost $85 per foot, a figure that includes all overhead expense and taxes. A round of holes 6 ft. or slightly deeper is drilled in an average of 1½ to 2½ hours, depending on the kind of ground to be broken. The blower is then started and it removes 3500 cu. ft. of free air per minute from the shaft, which enables the miners to re-enter the shaft in 20 to 30 minutes. The timbers are maintained within one set of the bottom of the shaft, which is made necessary by the condition of the ground. The work is in direct charge of Elmer Burt, superintendent.——The north-east cross-cut on the 800-ft. level of the Red Hill has been driven 155 ft. into the Florence, or 215 ft. from the Red Hill shaft. The strike and dip of the formation is the same as on the upper levels of the Florence and it is expected the vein undoubtedly will be entered within a few feet.

Hornsilver.—The Orleans Hornsilver Mining Co. has taken possession of the Orlean mine from J. W. Dunfee, former holder of the lease and option to purchase from the Champ D'Or. The new company has acquired this lease and the option to purchase. The officers of the Orleans company are: A. I. D'Arcy, of Goldfield, president; R. H. Downer, Gold-

field assayer, vice-president; H. D. King, of the Victory Divide company, secretary-treasurer. The company is incorporated for 1,500,000 shares of stock of a par value of 10c., non-assessable. Dunfee had shipped 11 carloads of $22 to $50 ore when the company took possession, the ore of best grade coming from a winze that has been sunk 50 ft. below the 580-ft. level. The shoot has now been opened for a lateral length of more than 100 ft. and a length of 70 ft. on the dip of the vein.

Railroad Springs.—The Allied Mining & Milling Co. has sent letters to stockholders asking them to buy an additional $20,000 worth of stock to be used in enlarging the concentrator to 100 tons capacity. The company now has a concentrator of 50-ton capacity, but during the last year work has been confined almost entirely to mine development because of the low price of lead. The statement issued by the company says: "It is estimated that close to $1,000,000 worth of ore is in the mine and dumps."



The Tri-State Zinc-Lead District

Round Mountain.—A report of the Round Mountain Mining Co. covering the period from January 1 to July 22 of this year says "the costs this year should be less than for 1920, but taking the 1920 costs as a basis, we have an indicated profit from placer operations of $58,750 for the year 1921". During this period the company received $11,405 as royalty from lode lessees.

Virginia City.—Options of purchase, involving the so-called middle mines group of properties on the Comstock lode, have been executed to Alex Wise, acting for Philadelphia investors. The properties included in the transaction are the Best & Belcher, Gould & Curry, Savage, Hale & Norcross, Chollar-Potosi, Bullion, and Exchequer, extending from the Con. Virginia south to the boundary of the United Comstock group. The sampling of the old workings and dumps was started August 20, under the direction of Albert Burch. R. B. McGinnis is superintendent. The first work was in the Hale & Norcross tunnel and on the surface of the Chollar. The sampling will take from two to three months.

The Comstock Silver Mining Co. has developed mill-ore in its Scheels group, working through the old Umatilla tunnel. Two winzes from this tunnel show pay-ore, the second, 400 ft. from the portal, showing ore uniformly 5 ft. wide. A cross-cut from this winze has broken into an old drift, apparently from the Overland shaft, and this drift is in ore. The property now embraces the old Overland mine, the Scheels group, the Jumper group, together with the Underground and Cosmopolitan claims. The Overland is equipped with well-constructed camp buildings, hoisting machinery, and a 10-stamp amalgamating mill, which is to be enlarged and provided with cyaniding equipment. The various properties in this group have produced about $2,000,000 from shallow workings in the three main north-trending lodes and four or five cross fissures.

Weepah.—The Electric Gold Mines Co. is cross-cutting west on the 100-ft. level of the main shaft, which has been sunk to 170 ft. This cross-cut is being driven toward the extension of a shoot of $50 ore that was found in the shaft at 80 ft. This shoot, which has only a slight pitch, is thought to be exposed in another shaft where there is a

6-ft. width of $40 ore. The shaft is being sunk on the footwall of a vein that has been opened for a width of 70 ft. On the surface of this vein, on the hanging-wall side, there has been opened an 18-in. width of ore from which assays of as high as $600 have been obtained. This ore is quartz containing coarse gold.

NEW MEXICO

Las Cruces.—Official announcement is made that C. A. Petterson and associates of Chicago, who have just bought of C. P. Cramer 32 claims covering practically the entire mineral belt of Georgetown, in Grant county, New Mexico, west of Las Cruces, will soon begin operations on a large scale. The old dumps show more than 200,000 tons of ore averaging $11 per ton. The cost of mining, milling, and treating by the cyanide process should not exceed $6 per ton, so the dumps alone should yield a profit. Estimates place the value of the ore in sight at $150,000. The extensive workings of the old mines make these calculations easy. The property is east of Hanover and five miles northeast of Santa Rita, where the copper mines of the Chino Copper Co. are. The buildings on the property are to be repaired at once. The Georgetown mines are the oldest in Grant county. Silver was discovered there in 1866. The principal producing mines were the Naiad Queen, Commercial McGregor, McNulty, and Satisfaction.

OKLAHOMA

Miami.—W. O. Cralle, president of the Miami School of Mines, announces that the institution will open on September 12, although entrance examinations will be held on September 7. The school has been made a part of the University of Oklahoma and students can now get the first two years of university work at Miami. This will result in a much larger enrollment this year, it is believed.

UTAH

Eureka.—The Eureka Bullion Mining Co. has resumed operations at its property in the East Tintic district, following a shut-down of several weeks. The company is seeking to open on the 1050-ft. level an ore-deposit discovered on the 800-ft. level. This deposit was found on the 925-ft. level, and a drift on the 1050-ft. level gives samples assaying 9 oz. silver and 2.5% lead.

Ore shipment for the week ending August 13 totaled 178 cars, as compared with 152 cars for the preceding period. The Tintic Standard shipped 63; Chief Consolidated, 38; Iron King, 15; Iron Blossom, 14; Eagle & Blue Bell, 13; Victoria, 12; Centennial Eureka, 5; Colorado, 3; Mammoth, 3; Gemini, 3; Dragon, 2; Sunbeam, 2; Swansea, 2; Tintic Drain Tunnel, 2; and Eureka Mines, 1.

During the second quarter of the current year, the Chief Consolidated Mining Company shipped 22,560 dry tons of ore, averaging 0.06 oz. gold, 33.92 oz. silver, 21.28% lead, and 1.52% copper. The average gross value per ton was $40.02; smelting, freight, and sampling amounted to $18.46, leaving a net value of $21.56 per ton, or a total of $486,352. The net profit for the period was $45,239, as compared with $43,012 for the first quarter of 1921. The total amount of development work done during the quarter was 10,452 ft., of which 8145 ft. was drifting, 2208 ft., raising, and the remaining 99 ft. winzes.

Milford.—Work has been resumed at the Independence Silver Mining Co.'s property, following a visit from O. Holm, of St. Paul, president of the company. From prospecting work alone, the company has shipped 27 cars of ore, averaging $2 in gold, 27 oz. in silver, and 47% lead. The first work will be the sinking of the shaft to the 500-ft. level, according to Edward Bardsley, manager.

Moab.—Andrew Nylund and associates, who have been operating uranium claims in the Gateway, Colorado, district, have moved their equipment to a uranium deposit near Thompsons and will begin active mining operations. During the past three weeks 1000 sacks of uranium ore has been shipped from this district.

Modena.—A special meeting of the stockholders of the Bull Valley Gold Mines Co. has been called by M. R. Evans, president, for the purpose of ratifying the action of the Board of Directors in issuing an option and lease to J. M. Worton and Burton S. Rupp, whereby they are granted the privilege of purchasing the property of the company for the sum of $105,501; $14,066.80 to be paid within 60 days after ratification, and the balance, $91,434.20 to be paid within two years. A royalty of 10% on all ores extracted will be paid to the company during the two-year period, such royalties to apply on the purchase price. The holdings of the company consist of 16 patented lode claims in the Goldstrike district, about 40 miles from here. It is stated that free-milling gold quartz is found in a 3-ft. vein that assays as high as $50 per ton. The milling-ore in sight is estimated at 10,000 tons, averaging $20 per ton.

Park City.—Shipments of ore for the week ending August 13 amounted to 1485 tons, as against 1562 tons the preceding week. The Judge allied companies shipped 557 tons; Silver King Coalition, 493; and the Ontario, 435.

Salt Lake City.—The United States Smelting Co. has announced a reduction in smelting-rates of 1c. per ounce on silver and ¼c. per pound on lead, owing to a reduction in the freight-rate on bullion. The reduction became effective on August 11.

WASHINGTON

Springdale.—At the Queen mine, near Deer Trail in Stevens county, workmen recently broke into 10 in. of ore that carried an average of 1080 oz. of silver per ton. This property is now owned by the Silver Basin Mining Co., in which Charles Turner, of Davenport, and associates are the stockholders.——The Aichan Bee Silver-Lead Mining Co., of Spokane, which owns property adjoining the Queen, intends to install compressor machinery and push the extension of the tunnel, which is now in 477 ft., and continue other development.

BRITISH COLUMBIA

Anyox.—The Granby Consolidated M. S. & P. Co.'s engineers have examined a number of properties recently, among them being the Silver-Standard mine, near Hazelton, the Carmichael property, on Copper river, the Kleanza Copper Co. property, at Kleanza creek, and properties in the neighborhood of Whitehorse, Yukon. The examination of the Silver Standard, which is a silver-lead-zinc property, suggests that the company contemplates the addition of lead and zinc smelting plants to the smelter. With the opening up of the Keno Hill silver-lead deposits, in the Yukon, there should be ample lead ore for a smelter on the northern part of the British Columbia coast, and independent mine-owners in the northern part of the Province would welcome such an addition to the Granby company's plant.

Nelson.—The California Mining Co., owner of gold properties in British Columbia, will resume operations as soon as alterations in the mill are completed. The property is three miles south of Nelson and is composed of the California, Exchequer, and Athabasco groups of 13 claims. The development of the California has been proceeding for several years by the company, which is controlled by Washington and British Columbia interests. The properties adjoin. The Exchequer carries an extension of the California vein, and the Athabasca is in line to carry the vein, but the development necessary to the establishment of proof of continuity has not been performed. All levels of the California have been run to the end-line of the Exchequer. The mine is equipped with a modern mill, a cyanide plant, and an air-compressor, and the machinery is operated by water-power.

Ore is vailable for immediate milling, but additional development work will be necessary to assure a continuous operation of the mill. J. H Turner, of Spokane, is superintending operations.

Telegraph Creek.—A. St. Clair Brindle, of Victoria, reports the finding of two important deposits of pyrrhotite, which are said to contain arsenides of nickel and cobalt, in the Liard mining district.

Trail.—Ore receipts at the Trail smelter for the first week in August, which amounted to 8263 tons, contained contributions from ten mines. The following were the shippers: Freddy Lee, Sandon, 24 tons; Knob Hill, Republic, 85; Kokoma, Beaverdell, 8; North Star, Kimberley, 46; Majestic, Sandon, 5; No. 1, Ainsworth, 33; Surprise, Republic, 322; Skyline, Ainsworth, 20; Whitedater, Retallic, 39 tons; and Bingo, 826 lb. The company's mines shipped 7255 tons.

Vancouver.—George Wingfield, of Reno, Nevada, has filed suit against the Taylor Mining Co., the Taylor Engineering Co., and Charles M. Rolston, of Vancouver, for $182,322, being the amount of a mortgage and accrued interest on the Dolly Varden mine. When, in the closing hours of the 1920 session, the Provincial Legislature by a special act took the case out of the courts and vested the title to the mine in the Taylor Mining Co., one of the liabilities assumed by the Taylor company was a mortgage in favor of Wingfield for $150,000, which from non-payment of interest has grown to the above amount. Within the last few weeks the Taylor company has re-opened the Alice Arm-Dolly Varden railway, and has shipped 500 tons of ore that was lying on the dumps.——W. H. Collins, director of the Canadian Geological Survey, has been making a tour of the more important mines of the Province, accompanied by W. Fleet Robertson, Provincial Mineralogist. The director stated that British Columbia was receiving one-third of the total Dominion grant of $170,000 for research and field work. ——H. A. Guess, president of the Premier Gold Mining Co., passed through here recently on his way to the mine. The company is erecting ore-bunkers at Stewart.——J. J. Warren, president of the Consolidated M. & S. Co., returned recently from a trip to the Orient, where he has been in the interest of his company, which has made several shipments of copper to Japan.——Heywood & Co., Ltd., of this city and Calgary, have underwritten $350,000 worth of shares in the Mount Stewart Oil Co., which has been formed to develop petroleum and natural-gas rights at Fort Norman and at Great Slave Lake.

MEXICO

Casas Grandes, Chihuahua.—Francisco Zorrilla, of Ciudad Juarez, has located El Progreso, a new group of prospects in the Capulin mountains near Casas Grandes.

Chihuahua.—Federico Ramos, of Chihuahua City, has filed on a group consisting of 20 pertenencias, situated in the Santa Eulalia silver district. The group is to be known as the Carmen. It lies adjacent to the Susana, Las Plomosas, and La Union. The Chihuahua smelter is still operating in full blast with eight lead-furnaces. The company has recently acquired a large number of valuable mining properties throughout the States of Chihuahua, Durango, and Coahuila.——About fifty tons of ore is being received at the Chihuahua plant from the San Mateo mines in the Velardena district. Carter Barker, of the Hileta Gold & Silver Mining Co., is arranging to make shipments of ore from Velardena to Chihuahua.——The Ahumada group of ten claims has been filed on and is being opened up by Antonia Zacatecas, of Juarez. The property is situated in Los Lamentos mountains and near the village of Gonzales. The ores carry lead, zinc, and silver.——A strong vein carrying gold, silver, lead, and copper has been discovered and located by Jesus Trevino and associates near Carmen camp. The filing of eight claims has been made at the Parral mining agency under the name of La Tenoxtitlan.——Leopoldo Felix has made application for title to La Gloria mines, which compose eight claims situated in the Guadalupe y Calvo district.——Marcos C. Jay, of Guadalupe y Calvo, has made a new filing on the Cuatro de Julio group, situated in the Flores arroyo.

Chinipas, Chihuahua.—Lorenzo Diaz has filed on a group of gold and silver mines to be known as Esperanza, situated in the municipality of Guazapares within the jurisdiction of the Chinipas mining agency. La Fabulosa, a group of two promising claims, has also been taken up by Sr. Diaz in the same vicinity. Jacob W. Breach has been appointed to make the official survey and plans for both locations.

Guaymas, Sonora.—Reparation for the murder of Edgar Bristol Davis, an American mining engineer, on March 21, 1921, has been promised. On March 28, Consular Agent J. N. Gibbe, of Cananea, reported the discovery of the body, stripped and robbed, near Mazocahui, Sonora. Guilt for the crime became fastened on a Mexican found to be wearing articles of clothing taken from the dead man. The body of Davis had been robbed of a sum of money which he had been known lately to possess, and his horse, saddle, and camping equipment were also stolen. In addition to the circumstantial evidence, the Mexican had boasted, while under the influence of liquor, of the killing. Although Consul Yost, in whose district the murder occurred, the brother of the slain man, John Davis, manager of the Bunker Hill mine, Tombstone, Arizona, and others have been tireless in their efforts to have the suspected slayer apprehended, no action had been taken by the Mexican authorities; over four months has elapsed in which the party suspected of the murder has been at large.

Hermosillo, Sonora.—It is understood that the Governor of the State is planning to operate some of the principal gold mines of the Ortiz district for the benefit of the State. Employment will thus be given to a large number of idle miners and relieve considerable suffering.

Conferences are being held between State officials and owners of the copper mines. The low price of copper and the lack of fuel and railroad facilities make it difficult for the mines to work profitably.——The Arizpe silver mines have been acquired by Americans, who are making preparations to operate them on a large scale.——A deposit of silver ore is said to have been discovered in the Soyopa mines of this State.

Monterrey.—The Cia. Negociacion Minera Jesus Maria of Saltillo, in which Ernesto Madero is largely interested, is considering plans for the development of its mines in the State of Coahuila.——Albert Genty has just finished the construction of an eight-mile spur-track railroad to his mines at Sierra Ramirez, State of Durango. He has started the development of his Calaverita group of mines in the San Juan Guadalupe district, and will make shipments of ore soon to the A. S. & R. smelter at Aguas Calientes.——An American company is being organized to take over the Salida mines in the Velardena district, State of Durango, which was forfeited for non-payment of taxes.——Juan A. Gallarod, of Durango, has obtained title to a group of gold and silver claims in the Huizar mountains, near the capital of the State, and is preparing to start development work.

At the present rate at which forfeited mines are being re-located it will not be long before all of them have been taken up. One of these properties is the Descubridora group, situated in western Durango, which has just been taken up by M. Chavez.——In the Concepcion del Oro district, State of Zacatecas, several groups of claims have been filed on recently. In the Mazapil camp Jose R. Zamore has applied for title to two claims that give promise of becoming copper producers.——William Friedrich, of San Antonio, Texas, and associates are arranging to start

development work upon a group of mines in the Chalchinuites district, State of Zacatecas.——Re-location of the old Anexas de Zaragoza mines, situated in Los Muertos mountains, State of Zacatecas, by J. R. Dyer and associates is announced. The mines will hereafter be known by the name of Tenochitlan. Improvements are to be made.—— In the San Juan de Guadalupe camp, State of Durango, Eugene Leroy has acquired title to the Gardenia and Chabusco mines.——Several old mines in the Topia district, State of Durango, have been filed upon by W. Dartling.—— The San Francisco Mines of Mexico are having plans made for a 275-ton ore flotation plant which it will build at its San Francisco del Oro mine, in the Parral district. H. G. Hunter is engineer in charge of the property.——The American Smelting & Refining Co. will resume operation of its Tecolote mine in the Santa Barbara district, State of Chihuahua, the latter part of this month, it is stated.

ONTARIO

Cobalt.—Operations have been resumed on the Violet property of the La Rose Consolidated. This has been made possible by reason of the improved economic situation, both in respect to the lower cost of supplies and in the higher efficiency of miners.——The mill on the Hudson Bay mine will be re-opened and about 6000 tons of broken ore will be treated. No development work will be undertaken at present.——During July the Bailey custom mill treated 4043 tons of ore and realized gross earnings of $12,129.51. The Bailey mine itself shipped 1262 tons of ore during the month.——A number of properties will be re-opened this fall in the Elk Lake district, including the Cane Silver Mines, Triangle Silver Mines, and Ontario Solid Silver Mines. ——Road work on the highway from the centre of activity in the Gowganda field to the railhead at Elk Lake is progressing rapidly and, after this year, it will be possible to operate motor-trucks during the summer months. This will greatly reduce transportation charges.——Sinking on the Waldman property of the Oxford-Cobalt Co. has reached a depth of 45 ft. Good assays in silver have been obtained all the way from the surface.

A meeting of the stockholders of the Bailey Cobalt Mines will be held on September 23 for the purpose of concluding an arrangement whereby the company will be in a position to take possession of 425,000 shares of stock in the more recently incorporated Bailey Silver Mines Co., which controls the Bailey Cobalt, together with what was formerly the Northern customs concentrator.——During July the Nipissing mine produced $166,363, of which $140,983 was in silver and the balance of $25,380 in cobalt. The low-grade mill treated 7258 tons; the high-grade plant treated 185 tons. The refinery shipped 370,117 oz. of silver.——Total silver production from the mines in the Cobalt field during July reached a little over 700,000 oz. In the order of their importance, the producers were: Nipissing, Mining Corporation, Coniagas, O'Brien, La Rose Consolidated, Bailey, and Chambers-Ferland.——An interview with officials of such mines as have not yet resumed operations reveals a general opinion that a movement toward general resumption of work cannot be expected until such time as further reductions take place in the cost of material as well as wages to the employees.——The completion of a well-graded road from Elk Lake to Gowganda assures the Gowganda silver-mining field greatly improved transportation facilities for the summer of 1922. The use of motor-trucks is expected to replace the horses and wagons now in general use. The projected light, narrow-gauge railway through the Gowganda district, running from Swastika to West Shining Tree, by way of Fort Matchewan and Gowganda, is still in a state of uncertainty; the promoters have made the announcement that arrangements are being concluded in Toronto and Montreal to sell the bond issue of $1,500,000.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Charles H. White is at Wallace, in the Coeur d'Alene.

E. R. Richards has left Pioche and is now at Berkeley.

J. K. Turner has returned to Goldfield from New York.

Robert R. Hedley is at the Arlington mine, Slocan, B. C.

W. Earl Greenough, of Spokane, is at Lander, Wyoming.

John P. Gray, of Coeur d'Alene, Idaho, was at Salt Lake City recently.

H. V. Winchell is examining the Dundee-Arizona mine at Jerome, Arizona.

Frank W. Royer has returned to Los Angeles from Virginia City, Nevada.

Harry Sordy, superintendent for the Almeda Mines Co., of Almeda, Oregon, is in Alaska.

Louis J. Joubert, who has been at Medellin, Colombia, is at Camptonville, California.

Earl H. Young has been appointed Professor of Geology in the Montana School of Mines.

C. N. Schuette is manager for the Silver Gulch Mining & Milling Co. at Dunton, Colorado.

E. P. Mathewson has been appointed consulting engineer to the Burma Mines, Ltd., of London.

Scott Turner has returned to Toronto from a visit to the Granby company's plant at Anyox, B. C.

John Dern, of Salt Lake City, sailed from New York on August 16 for an extended tour of Europe.

R. B. Lamb, of New York, is inspecting mining property in the Clifford district, Nye county, Nevada.

George S. Rice, of the U. S. Bureau of Mines, was in San Francisco this week on his return from south-eastern Alaska.

Albert Burch has been at Virginia City in connection with negotiations involving a group of mines on the Comstock lode.

A. E. Radner, of Bessemer, Michigan, who is in charge of iron-mining operations on the Gogebic range, is at Virginia City.

Clyde E. Williams has succeeded **O. C. Ralston** as superintendent of the Northwest Experiment Station of the U. S. Bureau of Mines.

P. H. Reagan, of Big Springs, Texas, has become engineer for the Gulf Mining & Reduction Co., at San Antonio, Baja California, Mexico.

Charles Bocking, manager, and **E. V. Daveler**, mill superintendent for the Butte & Superior Mining Co., were at Salt Lake City last week.

J. F. Callbreath, Secretary of the American Mining Congress, on August 24 delivered an address at the Engineers Club, San Francisco, on 'The Mining and Oil Industry'.

Edward H. Wisser has left the engineering department of the Shasta Zinc & Copper Co. to become mining engineer to the Silver Gulch Mining & Milling Co. at Dunton, Colorado.

F. G. Janney, who resigned recently as general superintendent for mills for the Utah Copper Co. at Garfield, is in New York, where he will be Eastern representative for the Stimpson Equipment Co., of Salt Lake City.

J. F. Sleeper, chemist and author, lately manager for Ricketts & Co., Inc., and research analyst for the testing laboratories of New York, Inc., recently resigned from the latter position and will be open for engagement in September.

R. A. Hardy, superintendent of mines for the United Comstock Mines Co. at Gold Hill, Nevada, is on his way to Alaska to inspect the Alaska Gold mill. Some of the equipment is to be moved to the site of the United Comstock's 2000-ton mill, now in course of construction.

THE METAL MARKET

METAL PRICES

San Francisco, August 23

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6.50
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

August 22.—Copper is inactive but steady. Lead is quiet but firm. Zinc is dull and unchanged.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Aug. 16	61.25	38.00
" 17	62.00	38.50
" 18	62.00	38.37
" 19	62.12	38.62
" 20	61.87	38.50
" 21 Sunday		
" 22	61.25	37.75

Average week ending	Cents	Pence
July 11	58.69	36.75
" 18	60.25	37.56
" 25	60.14	37.85
Aug. 1	61.66	39.05
" 8	61.46	38.62
" 15	60.81	37.02
" 22	61.78	38.29

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	59.55
Mch.	101.12	125.70	56.08
Apr.	101.12	119.56	59 33
May	107.23	102.69	59 90
June	110.50	90.84	58.51
July	106.36	92.04	59.99
Aug.	111.35	96.23	....
Sept.	113.92	93.66	....
Oct.	119.10	83.48	....
Nov.	127.57	77.73	....
Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Aug. 16	11.75
" 17	11.75
" 18	11.75
" 19	11.75
" 20	11.75
" 21 Sunday	
" 22	11.75

Average week ending	
July 11	12.62
" 18	12.62
" 25	12.43
Aug. 1	12.04
" 8	11.75
" 15	11.75
" 22	11.75

Monthly averages

	1919	1920	1921
Jan.	20.43	19.25	12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	12.74
June	17.53	19.00	12.83
July	20.82	19.00	12.46
Aug.	22.51	19.00	....
Sept.	22.10	18.75	....
Oct.	21.66	16.53	....
Nov.	20.45	14.63	....
Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Aug. 16	4.40
" 17	4.40
" 18	4.40
" 19	4.40
" 20	4.40
" 21 Sunday	
" 22	4.40

Average week ending	
July 11	4.43
" 18	4.40
" 25	4.40
Aug. 1	4.40
" 8	4.40
" 15	4.40
" 22	4.40

Monthly averages

	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.78	4.32
May	5.04	8.55	5.01
June	5.32	8.43	4.57
July	5.53	8.63	4.75
Aug.	5.78	9.03	....
Sept.	6.02	8.08	....
Oct.	6.40	7.28	....
Nov.	6.76	6.37	....
Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	30.36
May	72.50	54.99	32.50
June	71.83	48.33	29.39
July	70.11	49.29	27.69
Aug.	62.20	47.60	....
Sept.	55.79	44.43	....
Oct.	54.82	40.47	....
Nov.	54.17	36.97	....
Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date	
Aug. 16	4.70
" 17	4.70
" 18	4.70
" 19	4.70
" 20	4.70
" 21 Sunday	
" 22	4.70

Average week ending	
July 11	4.77
" 18	4.76
" 25	4.72
Aug. 1	4.75
" 8	4.70
" 15	4.72
" 22	4.70

Monthly averages

	1919	1920	1921
Jan.	7.44	9.56	5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	6.49	8.76	5.33
May	6.43	8.07	5.37
June	6.91	7.92	4.96
July	7.78	8.18	4.41
Aug.	7.81	8.31	....
Sept.	7.57	7.84	....
Oct.	7.82	7.50	....
Nov.	8.12	6.78	....
Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	
July 26	47.50
Aug. 2	47.50
Aug. 9	47.50
" 16	47.50
" 23	47.50

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	50.00
June	94.40	85.00	49.50
July	100.00	88.00	47.75
Aug.	103.00	85.00	....
Sept.	102.60	75.00	....
Oct.	86.00	71.00	....
Nov.	78.00	56.00	....
Dec.	95.00	52.50	....

ZINC DURING FIRST HALF OF 1921

Figures compiled by C. E. Siebenthal and A. Stoll, of the U. S. Geological Survey, from reports submitted by all zinc smelters which operated during the first six months of 1921, show that the production of zinc from domestic ore in that period was 100,781 short tons, and from foreign ore 1744 tons, a total of 102,525 tons, as compared with 205,269 tons in the last half of 1920 and 258,108 tons in the first half. The stock of zinc held at smelters and in warehouse June 30 was 94,747 tons, having increased from 71,037 tons at the end of 1920 and 29,892 tons at the middle of that year.

From the foregoing figures and from the statistics of imports and exports as recorded by the Bureau of Foreign and Domestic Commerce, it is calculated that the apparent consumption for the period was 83,965 tons, as compared with 147,783 tons in the last half of 1920 and 175,268 tons in the first half. In addition to the zinc produced from ore, 11,950 tons was re-distilled from zinc ashes, skimmings, and drosses. Much of this zinc was of grades above prime Western, and the total, added to the primary output, gives 114,475 tons, consisting of 13,358 tons of 'high' grade, 1106 tons of 'intermediate' grade, 17,466 tons of 'select and brass special' grade, and 82,545 tons of 'prime Western'. Electrolytic zinc amounted to 4617 tons, as compared with 27,591 tons in the last half of 1920 and with 24,035 tons in the first half.

The total number of retorts at plants at which there were some operations during the first half of 1921 is 123,528, as compared with 158,545 at the end of 1920. The number of retorts in operation on June 30, 1921, was 36,000, as compared with 56,000 at the end of 1920 and 95,000 on June 30, 1920. The average quoted price for prime Western zinc at St. Louis for the first six months of 1921 was 4.85c. per pound, as compared with 7.8c. for the year 1920. The price at the beginning of 1921 was 5.6c., but a steady decline brought it to 4.63c. at the middle of April. After rising to 5c. by the end of the month, it again fell by degrees and closed the half-year at 4.25 cents.

The demoralization of the zinc industry during the half-year with imports of 7405 tons, exports of 2255 tons, and apparent consumption of 83,965 tons, is strikingly shown by comparison with the two periods of 1919 and for the first half of 1920, when imports were nothing, exports from 70,000 to 90,000 tons, and consumption from 160,000 to 175,000 tons. The output of zinc by Belgian smelters in the first half of 1921 was 35,858 short tons, as compared to a total of 91,542 tons in 1920. The output in June was 4817 tons. It is understood that the monthly output has been limited by the Federation of Belgian Zinc Smelters to 5000 tons. World zinc stocks have been recently stated as about 160,000 short tons, exclusive of the stocks of sheet zinc, of which Belgium is reported to hold 45,000 tons.

MONEY AND EXCHANGE

Foreign quotations on August 23 are as follows:

Sterling, dollars:	Cable	3.67⅝
	Demand	3.68½
Franc, cents:	Cable	7.80
	Demand	7.82
Lira, cents:	Demand	4.51
Mark, cents		1.21

Eastern Metal Market

New York, August 17.

Buying of most of the metals is of moderate proportions, but the undertone of all the markets is fairly strong.

Demand for copper is light but prices are firm at recent low levels.

Buying of tin has been fairly good on a declining market.

The lead market is firmer and buying has been moderate.

There is no improvement in zinc, which remains steady at recent low levels.

IRON AND STEEL

The recent low dip in pig-iron prices led to buying on a scale probably not equaled in a year, and producers of foundry iron in all districts shared in the business. A good many consumers whose stocks had run down sensed the possibilities of the low rate to which output had fallen and decided to buy. In the past week furnaces at Chicago, St. Louis, Buffalo, and in Ohio and Pennsylvania districts have advanced their prices by 50c. to $2 per ton in an effort to limit the losses they have been making on raw material bought last year. While the extent of the actual rebound in the market is uncertain, the firmer stand of producers is marked and its effect will be closely watched.

The situation in finished steel differs from that of pig-iron. Steel works are being run and none are dropping out of the race. Buyers do not believe that the low point has been touched and are working close on stocks. The past week has shown continued irregularities in prices—on some products rather more resistance to declines—but generally a willingness to meet competition.

COPPER

There is no improvement in demand, which continues of moderate proportions. Reports from consuming centres to some sellers are that business is better and on the whole the future seems brighter. There seems to be no sellers of electrolytic copper below 11.75c., New York, or 12c. delivered, and some reports are to the effect that this price is disappearing. Current demand is being largely satisfied, however, at 12c., delivered. Some producers continue to remain out of the market. For future delivery 12.12½c. is quoted for September, with 12.25c. asked for October. Buying for foreign consumption has been fairly good recently.

TIN

The market, both at London and New York, has declined in the last week and the lower prices have attracted some interest. On two days last week a fair amount of business was done in future Straits tin. On the 11th about 150 tons was sold to dealers at around 26.62½c. and on the 12th about 600 tons was bought largely by consumers as low as 26 to 26.37½c. Since then the market has been stagnant. Straits tin, spot delivery, yesterday was quoted at 26.12½c., New York, as compared with 27.75c. a week ago and there has been a decline of about £8 per ton in London, where yesterday spot standard was quoted at £154 15s., future standard at £156, and spot Straits at £155 10s. Tin has appeared cheap to some buyers and a fair business has resulted. Arrivals thus far this month have been 2710 tons with 2810 tons reported afloat.

LEAD

A much better tone to the market is reported from most sources. Buying continues moderately good; prices are becoming firm and it is acknowledged that the lead market is the strongest of all. The leading interest continues to quote 4.40c., New York and St. Louis, but independents are asking 4.45c., New York, and 4.25c., St. Louis, and getting some business. Some reports are that the leading producer has stopped taking business.

ZINC

The market has turned exceedingly quiet again and sales are confined to small lots. There is a report that 4.15c., St. Louis, has been done, but this is doubted and cannot be confirmed. Current demand is being satisfied at prevailing quotations, which are 4.20c., New York, for prime Western for early delivery. For future delivery there is not much inclination to quote, but when bids are met, about five points higher are asked for September and October, respectively.

ANTIMONY

There is very little interest reported and prices have dropped to 4.50c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is obtainable from importers as low as 19c., New York, duty paid, but the leading interest continues to quote 24.50c. f.o.b. plant, for wholesale lots for early delivery.

ORES

Tungsten: There is practically no business and no change in quotations which remain nominal at $3 upward per unit, depending on the grade of ore.

Ferro-tungsten is inactive with prices nominal at 50 to 55c. per pound of contained tungsten.

Molybdenum: There are no developments with quotations unchanged at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: High-grade ore for blast-furnace use could probably be bought as low as 20c. per unit, seaboard, but there has been no test of the market.

Ferro-manganese: There are inquiries for about 500 tons but thus far sales this week have been confined to carload lots at prevailing quotations. The domestic alloy is held at $70 per ton, delivered, while the British is obtainable at $65, seaboard.

Spiegeleisen: Demand is confined to small and carload lots for which $26 to $27, furnace, is easily the ruling price.

Ferro-silicon, 50%, is in only moderate demand at around $60 per ton, delivered.

MEXICAN OIL INDUSTRY

If a balance were to be struck today, and the foreign investment in Mexico's oil closed out, it would be found that few companies, if any, have received enough income to repay them, says the latest issue of 'The Lamp', published by the Standard Oil Co. of New Jersey. They are dependent upon the future for the amortization of their capital advances.

Since July 1, when the new taxes went into effect, the situation as regards the most valuable oil, Southern light crude, has been as follows:

Average value of a barrel of this oil in the United States	$1.30
Actual operating costs of a typical large company for four months in 1921, excluding depreciation and depletion, per barrel	0.31
Royalty	0.05
Average cost of transportation to various points in the United States	0.43
Taxes under decrees of May 24 and June 7	0.36
Total	$1.15

The margin remaining, out of which the producer must recover cost of wells, leases, pipe-lines, terminals, etc., is 15 cents.

INFORMATION FURNISHED BY MANUFACTURERS

EFFICIENT MINE VENTILLATION

Mining engineers agree that the efficient ventilation of mines consist in the supplying of such volumes of circulating air at all working places as will enable the miners to work in comfort at maximum physical capacity with unimpaired health. Dan Harrington, mining engineer of the Bureau of Mines, in Technical Paper No. 251, says: "As regards the cost in dollars and cents, adequate and controlled ventilation would be justified by decrease of time lost by underground workers, by saving in compressed air used for blowers, and by better control of mine-fires. * * * With moving air-currents at working faces, workers may save as much as 50 to 70% of the time which is now lost in seeking relief from hot, humid, or vitiated air".

Charles A. Mitke, efficiency engineer, of Bisbee, Arizona, in his recent book, 'Standardization of Mining Methods', shows by carefully prepared charts covering an experience of 2½ years the following economies obtained where an efficient mechanical ventilating system was installed: The quantity of compressed air used was decreased approximately 50%. The tonnage per man increased from about 2½ tons to 7 tons, or approximately 180%. The cost of mining the ore decreased about 45%.

The ideal ventilation system supplies a sufficient volume of fresh air to dead ends, 'hot-boxes', shafts, stopes, raises, and winzes, and lowers the heat and humidity of these working places, making conditions more comfortable and more similar to those above ground. Without proper ventilation miners are able to work for only short periods until working conditions become difficult and it is necessary for them to go to the nearest air-course for relief. With efficient ventilation they are enabled to work comfortably without interruption and with increased physical ability. This saves a great labor waste with which mining superintendents and bosses are thoroughly familiar. High humidity in the mine-air is a cause of discomfort to workers almost equal to high temperature. When the two are combined a man's efficiency is at its minimum. While the increase of velocity and volume of air blown into a working place does not always reduce its temperature, the working conditions are almost certain to be greatly improved through a reduction in humidity.

In blasting, where a sufficient supply of air is supplied at the face, the miners are able to resume work within a few minutes after the blast, saving on an average at least one-half hour after each shot, and in all cases providing a much healthier working atmosphere.

By adequate mechanical ventilation the mining engineer can not only save time and increase production in blasting, but he can control all the relations existing between heat, humidity, gases, and evaporation in such a way as to avoid the other large losses of efficiency resulting when these important elements are neglected. To accomplish this a direct and dependable simple system for cheaply delivering large volumes of air anywhere in the mine is required.

Because of the conditions existing underground, a system of flexible easily portable tubing of large size is undoubtedly the best means by which to deliver an adequate supply of moving air to the working places. No objection has ever been offered to this system, excepting the failure of the tubing fabrics previously employed sufficiently to withstand the acid, fungus, and other destructive elements found underground.

The Du Pont company, one of the largest manufacturers of specially-treated impervious fabrics, has, through its intimate knowledge of this type of manufacturing, been able to produce a fabric which not only meets all the mechanical requirements of installation and service, but which has a chemical stability affording maximum resistance to the destructive agents encountered.

This fabric is not only extremely rugged and of great toughness and tensile strength, but its treatment is such as permanently to endow it with the required resistant qualities. It is in the development of this special fabric, called 'Ventube', that the Du Pont company claims a great advancement in mechanical ventilation.

'Ventube' is waterproof and fungus-proof and is highly resistant to the acid and gaseous conditions existing underground. This was thoroughly demonstrated by exhaustive tests extending over a period of 18 months in mines where these conditions are particularly severe.

By the use of 'Ventube', which readily conforms to any angle or curve, any part of the mine, regardless of how irregular its approaches, can be quickly reached. A single workman can put up 2000 ft. of 'Ventube' in one shift, without the use of any special tools, and can take it down as easily. Every part of the equipment used for coupling and suspending 'Ventube' in any position is simple, substantial, and practically fool-proof.

The tubing is supplied in standard lengths of 25, 50, and 100 ft., in standard diameters of 8, 12, and 16 in. One man can easily carry 100 ft. of 16-in. 'Ventube' on his back.

The ends of all 'Ventube' sections are equipped with Braly patent ring-couplings. All that is necessary to fasten two sections together is to squeeze either one of the rings to reduce its diameter and slip it through the other. Then pull back so that the edge of the inside ring rests snugly against the flange of the outer ring. The 'Ventube' fabric acts as a gasket and prevents leakage at the joint.

Fittings such as L's, Y's, T's, angles, reducers, screens for use in raises, fan-nipples, 10-ft. sections for raises, and offsets are all supplied in 'Ventube' material with regular 'Ventube' couplings in all standard sizes.

In all these fittings the use of exposed metal parts has been avoided, thus giving a life equal to that of the tubing itself and affording the same ease of connecting and repairing. As a support for 'Ventube' No. 8 B. & S. gauge galvanized-iron wire hung close to the roof and stretched tightly is recommended. Supports should be about 15 ft. apart but close enough to prevent sagging. The 'Ventube' is hung from the supporting wire by suspension hooks furnished for attachment in grommets provided in the suspension seam of the tubing.

For hanging 'Ventube' in shafts or raises a special suspension-collar is fitted around the regular coupling and supported so as not to pull upon the section of tubing above it.

Where 'Ventube' is run up-grade a suspension-collar is attached to the last coupling and supporting wires are run from it to a clamp on the suspension-wire or to a convenient sprag.

Each line of 'Ventube' should have one special end-piece supplied with snap-hooks to be used as the blasting-piece. In extending the line as the face progresses additional sections should be inserted in the line just behind the blasting-piece, so that the hardest wear will be confined to this piece and practically all the patching will be done on it.

The blasting-piece is usually a 100-ft. section suspended by snap-hooks from a separate parallel supporting-wire running back into the workings about 200 ft. When in its advanced position, the rear of this piece is coupled to the main line, but before blasting the blasting-piece is uncoupled and quickly withdrawn upon its suspending wire. This is quicker and better than rolling or dragging this piece through the mud and water underfoot.

The Du Pont company supplies a special cement for permanent patching. Patches of 'Ventube' cloth are used. The torn section is deflated and the surface around the tear or hole and the surface of the patch are thoroughly washed with gasoline and a coat of cement applied to each. When this has dried, a second coat is applied and left to dry. The cemented portions are then hammered together between flat surfaces to secure perfect adhesion. The repaired section may then be immediately re-connected to the line, the patch becoming virtually a part of the tube. For temporary repair underground, a small patch can be quickly sewed on, if desired, and will usually answer the purpose very well.

WORLD'S BUSIEST BRIDGE DISMANTLED BY OXY-ACETYLENE TORCHES

The Rush Street bridge, at Chicago, the use of which has been discontinued since the opening of the new boulevard link-bridge, has been sold to a wrecking company for junk. The company that purchased the old bridge for $500 is using 'Torchweld' cutting-torches for all metal-work on the structure. Dismembered steel beams are dropped upon barges anchored beside the bridge and floated away. It is estimated that approximately 250 tons of metal will be salvaged for junk. The first bridge across the Chicago river at this point was erected in 1854, a wooden structure which was destroyed by the Chicago fire in 1871. In 1874, the bridge now being wrecked was built at a cost of $50,000. It was 240 ft. long and 60 ft. wide, and until 1900 was operated by steam. The Boulevard connecting-link bridge, which replaces the Rush Street structure, was completed recently at a cost of $16,000,000.

SYNCHRONOUS MOTOR CONTROL-APPARATUS AND EXCITERS

Supplementing the thorough description of synchronous motors given in its Bulletin No. 41,309, the General Electric Co. has issued Bulletin No. 48,032. In this bulletin the description of synchronous motor control-apparatus is divided into four sections: exciters, compensators, panels, and rheostats. There are four general types of exciters. These are direct-connected exciters, DD-0; direct-connected exciters, DS-2; belted exciters; and exciter motor-generators. In general, the bulletin says, direct-connected exciters are used with high-speed motors of over 500 or 600 r.p.m. For the slower-speed motors, it is cheaper as a rule to use belted exciters. For very large machines, or where it is desired to excite several machines from one exciter, motor-generators are recommended. The bulletin describes, with illustrations, the five standard types of direct-connected DD-0 exciters and the two types of belted exciters, as well as the other types mentioned. The four general types of compensators for use with synchronous motors are covered in similar detail, as is the case with the switchboard panel equipment and the rheostats. Diagrams of connections, and tables of compensator dimensions and of compensators for use with different motor-types, are included.

COMMERCIAL PARAGRAPHS

The American Manganese Steel Co. has moved its Western sales-office to the site of its plant at Oakland. The company's new post-office address will be Oakland Pier, Oakland, California. J. W. Plant is manager.

The Hercules Powder Co., of Wilmington, Delaware, has announced a reduction of ½c. per pound on all high explosives manufactured by the company. The new prices are to become effective immediately.

P. R. Hines has resigned as sales manager for the Dings Magnetic Separator Co., and has opened an office at 703 Lewis Bdg., Portland, Oregon, to do consulting work upon crushing plants, and concentrators, as well as to represent the Stephens-Adamson Mfg. Co. in the North-West.

The Leroy A. Kling Advertising Co. announces its incorporation under the name of **Kling-Gibson Co.** The members of the firm are Leroy A. Kling, Hamilton Gibson, Harry C. Phibbs, William R. Durgin, and Charles J. Keller. Their office is in the Consumers Bdg., 220 So. State St., Chicago, Illinois.

The Armstead Mines Co., of Talache, Idaho, announces that the **General Engineering Co.**, of Salt Lake City, has been retained as consulting engineer in connection with the design and construction of a 150-ton mill. Work was started on July 25; it is expected that the mill will be completed and operating by the end of the year.

The Allied Machinery Company of America, 51 Chambers street, New York City, has been appointed representative in all countries except the United States and Canada for the **Universal Crane Co.** The Allied Machinery Co. has offices in all the large countries of the world. The Universal Crane Co. makes 3- to 4-ton portable gasoline or electric locomotive-cranes.

Bulletin No. 63, recently issued by the **Wellman-Seaver-Morgan Co.**, describes the Wellman revolving car-dumper. This particular machine has been developed to meet the demand for a low-capacity machine, of simple construction, adaptable to plants where the first cost of installation is a governing factor, but where high efficiency, low operating cost, and minimum labor are required. It is a machine that is recommended by its simplicity and its ready adaptability to existing plants as well as to new plants.

The Cleveland office of the **Sullivan Machinery Co.** was moved, on July 1, from 810 Park Bdg. to room 824 Kirby Bdg. Ralph T. Stone is manager at Cleveland. The company also announces the establishment of a supply-depot and service-station for coal-mining machinery supplies and repair-parts at 7th avenue and 13th street, Terre Haute, Ind., with H. T. Wiley, formerly of the engineering department at the Claremont works, in immediate charge. This service-station will handle orders from the coal-mining customers of the company in Indiana and will be under general charge of M. C. Mitchell, manager for Illinois and Indiana, at the Railway Exchange Bdg., St. Louis, Missouri.

'Grinding Data No. 6', issued by the **Hardinge Company**, describes the performance of 8-ft. Hardinge ball-mills in metallurgical plants in the United States, Mexico, and Canada. The operation of the mills, both as primary grinders and as re-grinders, is described, the following details being supplied in connection with each installation: name of the company, character of material, size of the mill, size-analysis of the feed and of the product, the capacity, the speed, the power consumed, and the consumption of balls per ton of material ground. The booklet is arranged for loose-leaf binding, and the data are presented in compact form.

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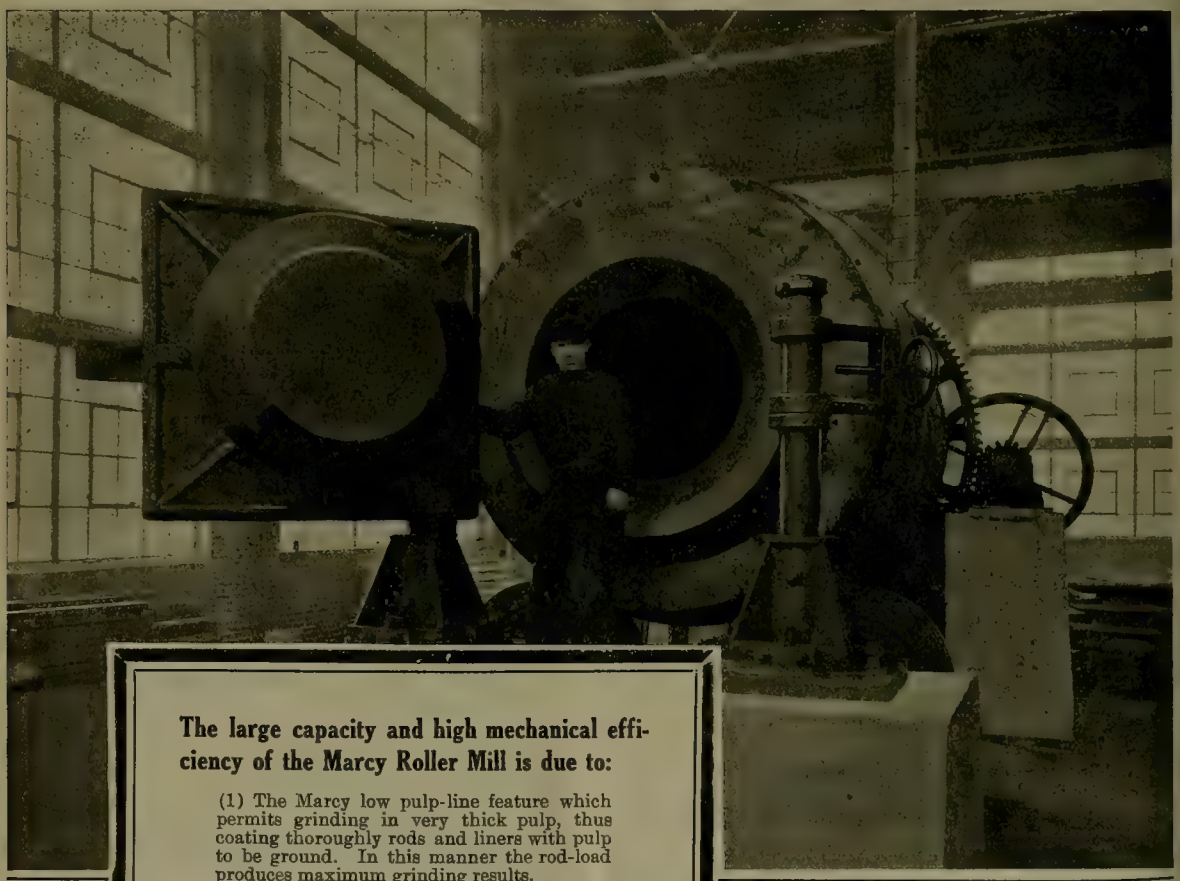
Reasons for Marcy Roller Mill Success



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T. A. RICKARD, • • • • Editor

THE next meeting of the Institute will be at Wilkes-Barré, in Pennsylvania, on September 12 and the three days following. It was at Wilkes-Barré that the Institute was founded fifty years ago, so that the occasion will mark the semi-centennial anniversary. Local arrangements are in the highly competent hands of Mr. R. V. Norris, assisted by Mr. Paul Sterling, as secretary. Anthracite coal and its production will be the chief topic of discussion.

DURING his recent visit here Mr. J. F. Callbreath, of the American Mining Congress, had to acknowledge regretfully that the McFadden bill is most unlikely to pass, by reason of opposition, among others, from the Secretary of the Treasury. Undoubtedly if this legislation had been introduced earlier, during the War, when the mining of gold was so severely handicapped, it would have commanded more support in Congress. Since then the conditions affecting gold mining have improved greatly and at the present time the outlook is brightening to a most encouraging degree. Mining for gold will be a marked feature of the general expansion of industry that will follow the present depression.

IN our 'News' department we quote from a speech delivered recently by Mr. F. H. Hamilton as the chairman at the annual meeting of a mining company in London. He strikes a virile note that rings pleasantly in times like these, particularly to the gold miner, for it is of the future of gold mining that he speaks. His reference is chiefly to the world's premier goldfield, but what he says applies equally well much nearer home. Our readers will note his confident prediction that the discount on the paper pound sterling is no temporary matter, and therefore that the so-called premium on gold in the countries using the British pound and other depreciated currencies will continue for some time, to the encouragement of gold mining outside the United States, where the dollar remains at a parity in terms of gold.

IN a recent issue, referring to mining in Siberia, we connected Mr. J. Power Hutchins with the Russo-Asiatic Consolidated Company. This was an error. He has long been connected professionally with the Russian Mining Corporation. The American engineers identified with the technical work done by the Russo-Asiatic are Messrs. R. Gilman Brown, H. H. Knox, T. J. Jones, D. P. Mitchell, and A. W. Stickney. The blunder was inexcusable, as we happen to know something about the history and technical progress of these companies. Incidentally we note that negotiations between the London board of directors of the Russo-Asiatic Consolidated and the Soviet government of Russia, for a resumption of mining operations in the Altai, are making good progress. In these negotiations the Russian government is represented by Mr. Leonid Krassin, and the company by Mr. Leslie Urquhart, who is chairman, and the founder of the company as well. Indeed to Mr. Urquhart is due much of the British exploitation of Siberian mining districts during the last ten years. In his work he has had the valued assistance of Messrs. H. C. Hoover and R. Gilman Brown, together with other American engineers, but the fact that he was born in Russia and knows the ways of the country intimately has helped greatly in smoothing difficulties. At last accounts he was in Moscow with five technical experts to arrange the last details of an agreement that is to facilitate a resumption of mining operations. Such a resumption is a matter of personal interest to many American mining engineers, to whom Siberia proved attractive in the days before the bolshevist chaos.

EXEMPTION from payment of tolls for American ships passing through the Panama canal is a subject that is being raised repeatedly in the press of this country. It is evident that public opinion, in Congress and outside, is in favor of such a step. Great Britain knows that the United States is considering the question, and wonders whether action is to be taken in defiance of the Hay-Pauncefote treaty, or whether an agreement will be made between both signatories beforehand. Recently it was stated at Washington that the question would be shelved until after the Disarmament Conference. We consider that this would be a grievous mistake. If the impression is given that outstanding matters of international dispute cannot be settled amicably by diplomatic means then it is evident that we should not expect any European nation to enter the Disarmament Conference without a suspicion that something will be 'put over'. Such an attitude would be fatal to the spirit of fair play that should animate the proceedings. So long as there is any sentiment in this country in favor of disregarding an international treaty or of interpreting it in a manner different from that adopted by the other signatory, it is

obvious that it is no time to propose disarmament. The keystone to any plan for disarmament is the assumption that all disputes can and should be arbitrated by negotiation. An amicable settlement of this particular question is inevitable eventually; why not now?

AT the second International Conference of Pure and Applied Chemistry, held recently at Brussels, the following recommendations relating to the unification of abstracting were proposed by the National Council of the Netherlands: That the Bureau of the International Union take the initiative in bringing together representatives of chemical journals that publish abstracts, with a view to discussing the formation of a central publication and its probable cost; and that the possibility of publishing an international chemical card-index be investigated, together with the approximate cost of establishment and maintenance. Unfortunately, mining and metallurgical engineers are more insular than their confreres in such matters; they hold no international meetings for the discussion of matters of general import; world-wide efficiency and economy in their own profession are obscured usually by national aspirations. Perhaps after the Disarmament Conference we may be in a better mood to co-operate. The results of the initiative of the chemical engineers in the matter of co-ordinating the work of abstracting and indexing will be watched with interest.

DISARMAMENT has been recognized by Great Britain as an effective method of preventing the economic waste that results from incessant warfare. For instance, when a large portion of New Guinea became a British Protectorate it was found that practically every tribe was at war with every other tribe. This condition arose because the Papuans were primitive folk; the bestial idea of killing for sport and for food was inherent with them. Moreover, the country was in chaos because almost every tribe had its own language, so that, where argument or conciliation was impossible, fighting was inevitable. The first Governor promulgated laws that ensured the destruction and confiscation of all weapons, and prohibited their manufacture. This was the first step in the right direction. The second edict prohibited the manufacture by, or the sale or gift of alcohol to, the natives; it was realized that alcoholism and belligerency go hand in hand. The history of Papua since that time has been one of unbroken peaceful development. Where the colonist goes, 'pidgin' English is spoken; it is not an ideal means of communication, but it is better than none; as Cecil Rhodes said, a common language is the greatest aid to peace. The principle of disarmament is economically sound; it should be adopted on a larger scale. The moral support of all the civilized peoples of the world is needed at the forthcoming conference at Washington. War may provide an opening for the higher qualities of human nature, but it also encourages the lowest passions; it leads to destruction and chaos. There are plenty of opportunities in peace time for the exercise of the virtues of courage and loyalty. The world would be a better place if a spirit of tolerance, brotherhood, and understanding were to take the place of the virtues of the battlefield.

SPEAKING of the sovereign balm of humor, a writer in the 'Valve World' soliloquizes thus: "To me one of the most cheering and hopeful assurances of continued cordial relations between the people of the United States and of Great Britain is given by the attitude of the two leading Anglo-Saxon humorous periodicals—'Life', in America, and 'Punch' in England. After a week of reading in the newspapers about all sorts of agitation and loud talking and raucous threatening and wild jabbering and senseless drivel on both sides of the water, how refreshing to open 'Life' and 'Punch' and see there the friendly and understanding smile, hear there the hearty laughter, read there the sentiments of tolerance and friendliness, of cordiality and genuine brotherhood. There Uncle Sam cracks his joke with John Bull, and John Bull sits down to a little friendly game with Uncle Sam, and the joke carries the essence of understanding and sympathy, and the game enlists our interest and invites our hearty co-operation. Humor is the sovereign balm for many of our fancied ills; so long as we can laugh and smile with 'Life' and 'Punch'—and the laugh and the smile will do us a world of good—we can afford to view without alarm the frantic efforts of malcontents to make Uncle Sam and John Bull quit joking and playing, and take to pulling hair." This is good philosophy; let us laugh more with, rather than against, our friends across the water.

UNDER 'Discussion' this week we publish a scholarly contribution from Mr. H. W. Turner on the magmatic origin of the principal copper minerals in the Engels orebodies. He makes a good case for his side of a most interesting argument. Next comes a plea for a protective tariff on magnesite and chrome. It will, undoubtedly, be read sympathetically by the Californian representatives in Congress. Mr. Albert E. Maas testifies concerning the alleged fabulously rich placers in Sinaloa, apropos of our reference to an absurd story published in the 'Examiner'. Undoubtedly the reporter is responsible for most of the exaggeration, but what can one expect if one gives an interview to a paper like Hearst's? Mr. J. H. G. Wolf makes an excellent suggestion for the indexing of current literature. Mr. A. D. Ramel, a prospector, writes in protest against the proposed revision of the mining law, and his letter is endorsed by five of his comrades. Undoubtedly the revision is most unpopular among the prospectors, and our legislators at Washington should take good note of the fact. In regard to the $50 per acre to be paid on claims that lack a discovery, we have received letters of inquiry as to whether the figure may not be a misprint, in view of the fact that the lump sum payable annually in lieu of assessment work is only $5 per acre. The text as sent to us says "fifty", not in figures but spelled. Five dollars

per acre in lieu of annual work comes to $100 on a 20-acre claim. This therefore is an alternative, not an increase. As to the $50 per acre, that applies to special conditions, namely, to a claim on which no discovery of a vein or lode has been made. Such a claim, as stated in Section 5, Clause B, may be held for five years, after which it becomes subject to re-location; but an opportunity to hold it for a further period, not exceeding five years, is given on the condition that the locator pay $50 per acre annually, such payment to include the requirement for assessment work. To pay $1000 per annum on a 20-acre claim is a heavy tax, but, it must be noted, it is due only on a claim upon which no discovery has been made after five years, and which therefore presumably has become potentially valuable only on account of the successful development upon adjacent ground. The regulation is meant, we suppose, to check the indefinite holding of claims by those unable or unwilling to explore and exploit them. It is hard on the prospector who holds the location in the expectation of selling it, without himself having done any successful development, and to that extent it plays into the hands of moneyed persons. Mr. William Crocker sends a thoughtful and most acceptable letter on the subject of allowing non-American issues to create dissension among our people. Incidentally he describes the compromise system of voting, which is ingenious and in accord with democratic principles.

Amalgamation and Cyanidation

A definition of an 'expert' may well include the qualification that he appreciates the limitations of his own specialty. The experienced cyanide engineer should be the first to realize the fact that only in exceptional cases could cyanidation entirely displace amalgamation without incurring avoidable losses. In the 'South African Mining & Engineering Journal' we note some interesting reminiscences from the pen of Mr. Andrew F. Crosse, to whom the profession is indebted for the results of much scholarly research and scientific interpretation. We learn of the first use of compressed air in the cyanide treatment of a gold ore on the Rand, and of the inventor's indifference to financial gain, for he never patented the idea and so saved the industry the economic waste of litigation. Speaking of the importance of amalgamation, Mr. Crosse compares the neglect to utilize this process, wherever practicable, to the attitude of a shopkeeper who would refuse to deal with any but credit customers. Gold obtained by amalgamation, as Mr. Crosse remarks, is ready cash.

In reviewing the recent history of the metallurgy of gold it is interesting to note how the industry has been swayed locally by fashion; and fashion insists, first of all, on the discarding of what is not strictly up-to-date. All-sliming was and is necessary in Mexico and elsewhere for silver ores, as at Kalgoorlie for telluride gold ores; but it was and is unnecessary for the majority of gold ores. Amalgamation was applied during the secondary crushing of Kalgoorlie ores because it was practicable and because grinding-pans were used. Elsewhere tube-mills were adopted, in which amalgamation treatment was not always feasible. In Mexico, on silver ore, amalgamation was only partly successful. Silver has a low specific gravity as compared with gold; it occurs mostly as the sulphide; amalgamation was not a logical procedure and was soon displaced by cyanidation. But no similar argument could be advanced in the case of the majority of gold ores; nevertheless, it is apparent that amalgamation has been abolished in many gold-recovery plants because of a desire to be up-to-date. There should be no question of antagonism between amalgamation and cyanidation in the treatment of gold ores. The experienced cyanide engineer will recognize that they are complementary processes, and that the ultimate metallurgical success of cyanidation, as judged by the amount of gold lost in the residue, will depend, to a large extent, on how great a proportion of the gold has been recovered by amalgamation before cyanidation is commenced. In a recent discussion on metallurgical methods in relation to gold production we cited an instance in which the average residue from a plant on the Witwatersrand contained 0.000046% of gold. To the publication of such a figure many will demur, affirming that the Rand ores are exceptionally amenable to amalgamation; but such is far from being the case. Comparatively fine grinding is needed; the metallurgists of the Rand realize that as much as possible of the work of gold recovery must be done before cyanidation is commenced; for the amount of gold in the residue after cyanide treatment is, to a great extent, proportionate to the amount of gold in the tailing coming from the amalgamation plant. If further proof of the utility of amalgamation be needed, it can be obtained nearer home. The excellent work at the Homestake, in South Dakota, is an example of exact precision in chemical manipulation on a large scale. The ore is first amalgamated to extract the coarse gold and thereby to diminish the subsequent cost of chemical treatment by cyanide; it is thoroughly washed during milling, and lime is added to counteract soluble refractories, as well as to assist coagulation and settlement. In Ontario, at the Dome mine, equally interesting results have been obtained by cyanidation after efficient amalgamation, by which a loss of only 0.000015% of gold in the residue was reported—under 10 cents per ton. Both these two results were obtained on comparatively low-grade ore. That of the Homestake averages about $3.50 per ton; the Dome ore is worth a little over $4 in assay-value. The need for amalgamation in the case of an ore of much higher grade is exemplified in the case of the Mysore mine, in India, where the material treated averaged $12.84 in gold during 1920, and the residue was about 20 cents, thus indicating an extraction of 98.4%. Here again, however, it is obvious that the low final residue was due largely to the comparatively small amount of gold in the pulp going to the cyanide plant; for the policy of the company's engineers has been to reduce the grade as much as possible by amalgamation before cyanidation is com-

menced. In this instance 89.7% of the gold is obtained by amalgamation, leaving only $1.89 per ton for cyanide treatment, by which the loss is brought down to only 20 cents per ton.

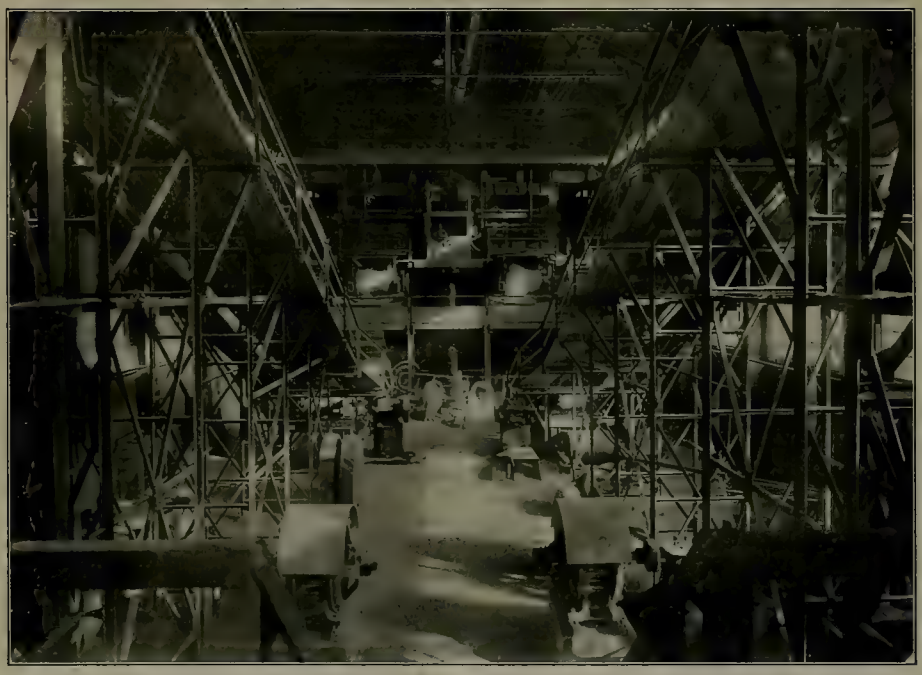
There are instances where amalgamation is technically impracticable; in some cases its adoption is economically inadvisable, because of the danger of theft. But gold is always gold and always heavy. Amalgamation, as Mr. Crosse remarks, represents ready cash; cyanidation means deferred payment; or, to change the simile, the older process is the right barrel of the metallurgical shotgun; if the first shot fails, the sportsman uses the choke-bore of the left barrel to overtake the escaping game. The two processes must go hand in hand, for they are complementary, the success of the entire operation being dependent on the efficiency of cyanidation, and that in turn being dependent on the efficiency of amalgamation. In these days of intensive search for something new, one is inclined to undervalue the well-tried aids to success. The scientific application of amalgamation is just as pertinent a study today as it should have been before the invention of the cyanide process. In conjunction with cyanidation it is the hope of a waning gold industry; the combination of the two processes will permit the exploitation of low-grade deposits, as well as the expansion of the reserves in high-grade mines. A procedure that involves the sliming or hammering of coarse gold, in an effort to make it soluble in cyanide solution, should be displaced by one that recognizes the fact that gold obtained by amalgamation is ready cash, and better in the safe than on the books.

The Use of Metals

At a time like this when the metal markets are in a state of acute depression it may be well to remind the pessimists among those engaged in mining that the present condition of affairs is temporary. Some people are talking and acting as if the world were about to return to the stone age and dispense with the use of metals, and as if therefore mining as an industry were destined to fall into irretrievable decay. They remind us of a child that, standing on the beach, imagines that the ocean is about to dry up because the tide is on the ebb. The sand is bared, the rocks are exposed, the pools are emptied, it looks as if the springs of the everlasting deep had failed. To a grown man the periodic rise and fall of the waters is a familiar phenomenon; even if he be but vaguely informed concerning the attraction of the moon and sun, he knows, from past observation and experience, that as surely as the waters recede so surely they will return. He is not frightened, as the child is; he counts confidently on the incoming tide at its appointed season. Some of our friends are childlike in their mental attitude toward the present depression. They say that "the bottom has been knocked out of mining" and they fail to see anything but gloom, as if a thick fog had fallen upon the sea, so that the turn of the tide was not even surmised. Any man of adult age, provided his memory be not atrophied and his powers of observation paralyzed, will know, from past experience, that there is "a tide in the affairs of men", and that a period of excessive prosperity is followed by a period of excessive depression, as surely as there is a balance in Nature. During the War the mining industry of this country benefited enormously from the abnormal demand for the metals consequent upon the needs of warfare on a colossal scale; unfortunately the great increase of production that accompanied the abnormal demand was allowed to continue even after everybody knew that the War was at an end and that the excessive consumption must cease shortly. For example, the closing of the copper mines and the curtailment of the zinc output were belated; these steps to restore the balance of supply and demand should have been taken immediately after the Armistice. They were postponed for more than two years, so that an enormous surplus of metals was accumulated. The leaders of the industry ignored the fact that the disorganization in Europe and the failure of the United States to make peace with the Central powers precluded the disposal of our metallic output to many European customers, including some of those with whom we had done a great deal of business before 1914. Now, however, production has been severely curtailed, a legal end has been put to our state of war, our customers in Europe are beginning to organize themselves for new business, and the great surplus of metals in this country is diminishing. Some months of comparative inactivity are still ahead of us, because those in control of our big mining enterprises deem it wise to deplete stocks until a vigorous demand comes from the consumers. It will come. "Man does not live by bread alone", he needs metals also. Civilized man requires food first, then clothes, and when these primary necessities have been satisfied he calls for metals. Our material civilization has a metallic foundation. Unless the whole world returns to political and industrial chaos, it will renew its insistent demand for the miner's products. The smaller the quantity of metals that is used now, the larger the quantity that will be needed shortly. The miner's turn is coming again soon. Sit tight, gentlemen.

Meanwhile, we venture to repeat our advice to the younger men—and it may appeal to some of the seniors as well: to use the time of inaction to some purpose. "All things come to him who knows how to wait", not to him who simply waits in the expectation of something coming his way. The short period of inaction that may be ahead of many of us should not be frittered away aimlessly. Take the opportunity to study some technical subject or to engage in special research. If you can afford it, travel. Go to some neighboring mining centre and make yourself familiar with the ore deposits, the mining practice, or the metallurgical methods of another district. If you need a holiday, play golf or go fishing; but whatever you do, make the most of the enforced leisure; play hard or work hard, but do not fool away the time, for the period of intense activity and expansive production that is surely coming will find full scope for all those who are prepared to take their part.

FLOTATION-CELLS IN SECTION 3 OF THE NEVADA CONSOLIDATED COMPANY'S MILL AT M'GILL, NEVADA



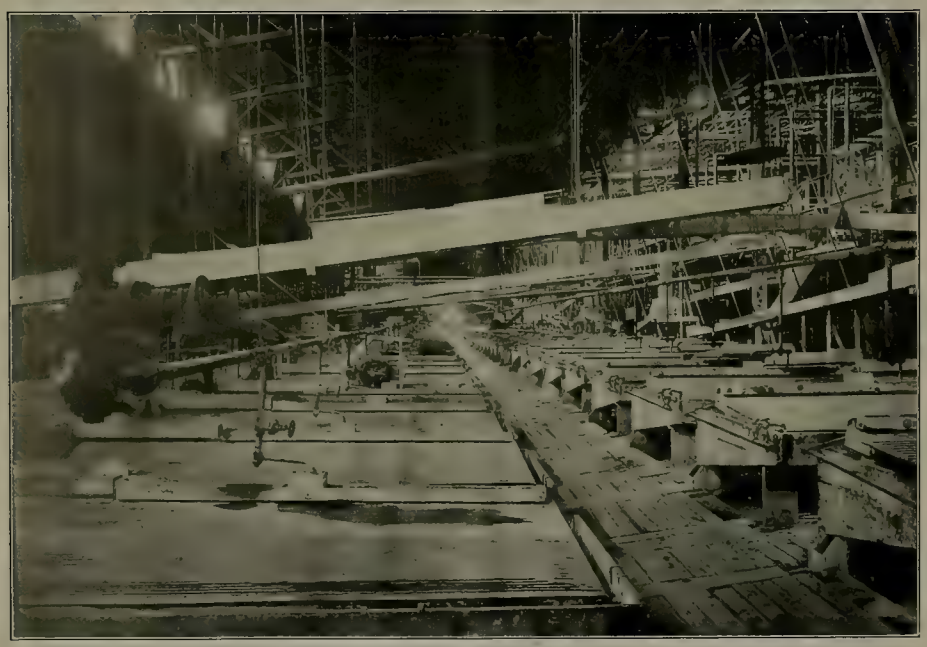
COARSE-CRUSHING PLANT: CONTROL-BOOTH IN THE CENTRE

BELT-CONVEYORS IN THE COARSE-CRUSHING PLANT

TRAVELING GRIZZLEY IN THE COARSE-CRUSHING PLANT

THE CONCENTRATOR BUILDING

THE BALL-MILL DEPARTMENT



FIRST ROW OF WILFLEY TABLES

Nevada Consolidated Copper Company—IV

Concentration of the Ore

By Arthur B. Parsons

As soon as it was definitely decided, in 1906, to build the milling and smelting plants at McGill's ranch, surveys were begun; and actual construction was started early in 1907, some months after the completion of the Nevada Northern railroad from Cobre on the Southern Pacific. The original design of the concentrator provided for ten units, each divided into two sections, having a capacity of 500 tons per 24 hours, or a total rated capacity of 5000 tons of ore per day. Only the four southern units were completed, for the reason that it was found possible to obtain a much greater capacity than had been expected. The records show that between 8000 and 9000 tons of ore per day was being treated in seven operating sections in June 1910, just two years after the first unit was put in operation; and since then as much as 4000 tons has been concentrated in a single unit, or eight times the quantity originally planned.

Among the principal characteristics of the ore that appeal to the millman are its unusual softness, which makes it easy to crush; and the large proportion of kaolin and talcose minerals it contains. These cause some difficulty in handling the dry ore in bins and chutes, and also make settling of the slimed pulp exceptionally slow. While the ore from the Ruth mine is a comparatively clean sulphide, containing chalcocite, chalcopyrite, and pyrite, there is a considerable admixture of oxide and carbonate minerals in the ore from the steam-shovel pits. The presence of these minerals increases the difficulty of concentrating, and has had an especially important bearing on the development of a successful scheme for employing froth-flotation. The proportion of pyrite in the ore has a direct effect on the grade of the concentrate, it being generally desirable to keep the proportion of pyrite in the concentrate, sent to the smelter, as low as possible.

Early Operations. An interesting description of the early operations of the plant appears in an unsigned article published in 'Mines and Methods' for September 1909. This publication will be remembered as the late Col. E. A. Wall's personal journal; although launched as a medium through which he might ventilate his ideas respecting the Utah Copper project and D. C. Jackling, it contained during its brief career many articles of considerable technical value. The accompanying flow-sheet of the concentrator, Fig. 1, is reproduced from 'Mines and Methods'. It is not entirely correct; for instance, the primary crushers were McCully gyratories, not Gates; and the classifiers were not "Richards vortex", but were a modification of that device, originated by Pope Yeatman. However, the flow-sheet gives a general idea of the scheme of treatment. It is typical of the methods of concentration used at that time, and contrasts remarkably with the simple routing of the ore in the present treatment by flotation. It will be noted that the material from the crushed-ore storage-bin is wetted immediately, preparatory to passage through a series of wet rolls with interposed trommels, the last of which returns, for further crushing, everything that fails to pass a $\frac{3}{16}$-in. screen. This fine product is divided into two sizes by a 2-mm. screen; the undersize is classified and concentrated on Wilfley tables, whereas the coarse is re-ground along with the middlings and part of the tailings from the first Wilfleys, together with oversize from 30-mesh Callow screens, which follow the re-grinding machines. The result is that nothing is allowed to escape as tailing that has not been ground to pass 30-mesh. Undersize from the Callow screens is classified in a four-compartment spitzkasten, tabled on Wilfleys, and finally concentrated on vanners. For the first product of the spitzkasten corrugated vanner-belts are used; for the remainder, smooth belts. Callow tanks are used to thicken the table-feed.

The original design called for four 6-ft. Huntington mills as re-grinding machines for each section. However, before the construction of the last unit was completed, it was decided to use Garfield Chilean mills instead of Huntingtons. In spite of some increase in the slime produced, the capacity and convenience of the Chileans so far surpassed that of the Huntingtons that one Chilean was added to the early sections, while three were added to do all the re-grinding in each of the new sections. This would indicate that one Chilean would crush approximately the same tonnage as two Huntingtons of the same nominal diameter. The maintenance of a full feed, of proper dilution, and the careful adjustment of the plows will do much toward diminishing the amount of slime produced.

In the 'Mining and Scientific Press' of June 11, 1910, under Staff Correspondence, the following summary of operations is given: "It is stated that as high as 10,500 tons have been put through in 24 hours. With only seven sections now in operation the plant already handles between 8000 and 9000 tons per day. The ore is first passed through McCully gyratory crushers. There are 8 sets of 15 by 36-in. coarse rolls, and 16 sets of 14 by 36-in. fine rolls, Allis-Chalmers type. In each section are 68 Wilfley tables and 48 Allis-Chalmers vanners; four elevators, 12-ply, 20-in.; four 6-ft. Huntington mills and one Gar-

field Chilean mill [this doubtless refers to the original sections]; eight Steptoe classifiers [an improvement on the so-called Yeatman classifier]; eight 2-mm. revolving screens and two ½-mm. screens for dewatering; and 46 Callow tanks. An important change in the practice consists in taking out No. 1 trommel, which was formerly used to take out an undersize product before wet-crushing in coarse rolls. This trommel having been taken out, the entire feed of the mill passes direct to the coarse rolls, which operate dry instead of wet as formerly. This change has served to increase the capacity, makes a steady feed possible, with no choking of the rolls. The change from wet to dry crushing, as applied to the coarse rolls only, and the installation of the Steptoe classifiers, are said to have resulted in adding 60% to the capacity of the mill. The process becomes a wet one after the pulp passes through the coarse rolls, of which there is one set to each section." I am informed that this statement of the increased capacity is accurate, the result, largely, of more uniform feeding to the rolls. It should be borne in mind that the ore is comparatively soft and is readily crushed.

Comparison of Steptoe and Garfield Systems. During 1911 a number of Richards-Janney classifiers were installed and Section 3 was remodeled so that its flow-sheet conformed in a general way to that used at the concentrators of the Utah Copper Co. at Garfield. Allen H. Rogers made a series of tests in November of that year to compare the results obtainable by the two systems, namely, the 'Steptoe' and the 'Garfield'. Although both are almost obsolete today, the fact remains that the design of the newest section, which has not yet been put into regular operation, provides for the use of Garfield roughing-tables in conjunction with Wilfley tables and flotation-cells. The following paragraphs are abstracted from Mr. Rogers' interesting report.

"The essence of the Garfield system is the production of a low-grade concentrate on Garfield roughing-tables, which is afterward re-dressed on Wilfley tables, and the re-classification of the fine spigot product from the primary classifiers. The ore passing the 2-mm. trommels is delivered directly to Garfield tables. These make a rough concentrate while the tailings are delivered to the primary classifiers. The effect of the tables is to produce a higher-grade feed to the Wilfley finishing tables, so that the ratio of concentration is low, and the streak of concentrates is wide, thus permitting the production of a higher-grade product with lower insoluble than would be possible from the direct feed. The tailings from these Wilfleys, consisting of true middlings, are delivered to the re-grinders. The Garfield table should deliver to the concentrate end all free mineral except that of the finest sizes, while the tailings which are fed to the classifier consist of true middlings and tailings with a little fine free mineral. This material, when classified, yields from the first spigots coarse material containing no free mineral but which still contains enough occluded mineral to make worth while grinding. The product from the first two spigots, therefore, is fed directly to the re-grinders. The finer spigots discharge the lighter particles consisting of clean gangue and very fine free mineral and these products are delivered to the secondary classifiers where they are still more closely classified, and then treated either on Garfield or Wilfley tables. The distinction of this flow-sheet is the production of the rough concentrate which is afterward re-dressed, and is particularly advantageous in the treatment of an ore, the ratio of concentration of which is high. In such cases where the proportion of concentrates from the ore is small, it is a great advantage to have a wide streak of concentrates on the tables making a finished product because the proportion of silica necessary to include with the concentrates in order to save all of the latter is much smaller than it is where the streak of concentrates is narrow. In a word, it increases the ratio of concentration without decreasing the recovery. This flow-sheet also aims more thoroughly to eliminate free mineral from the material requiring re-grinding, accomplishing this by what amounts to double classification, for the Garfield tables are, in effect, classifiers. Properly handled, it accomplishes this well, although, as operated during the tests, it did not show as good a result in this respect as Section 8, in which the Steptoe system is used. The disadvantage of the system is that it requires more equipment which occupies more space and requires more power and attention.

"In Section 8 [Steptoe flow-sheet] the ore passing through the 2-mm. trommels is delivered to the classifiers, the first three spigots of which deliver to Wilfley tables making finished concentrates. The middlings from the first-spigot tables is re-dressed and re-ground with the tailings from the same. The second- and third-spigot tables make middlings for re-grinding and tailings to waste. The foregoing middlings are classified and screened before being ground in order to eliminate fine free mineral. The Wilfley tables in this section are equipped with National riffles. This riffle differs from the Wilfley riffle in extending the full length of the table, and, along the line which would mark the end of the Wilfley riffles, each riffle has a wave, the effect of which is to subject the concentrates to a vanning motion, for in order to pass the wave, they are obliged to travel slightly up grade. The effect of these riffles is, apparently, to decrease the necessity for delicate adjustment of the table. It would appear, however, from observation, that they require more water, and that, where the feed is not closely classified, it is difficult to keep the very fine sand out of the concentrates.

"In theory, this flow-sheet aims to remove the free mineral before re-grinding, by direct concentration. The primary tables are fed with closely classified material and it is conceded that all gangue falling from the first spigot of the classifier merits re-grinding. From the second and third spigots, clean tailings are made, while the middlings from these tables are re-ground. The screening to which these are subjected before re-grinding is intended to remove any fine free mineral that they may contain. This is accomplished to a considerable extent."

Although the proportion of free mineral lost in the tailing was much higher in Section 3 than in Section 8, thereby suggesting that more careful attention to the operation of tables and classifiers might alter the final result, nevertheless, Section 8, using the Steptoe flow-sheet, effected a better recovery of copper, had greater capacity, and produced an equally clean tailing. Fewer machines were required and the cost of operation and maintenance was probably lower.

One section of the mill followed the Steptoe flow-sheet, but differed from Section 8 in that two sets of rolls, 35 in. by 16 in., running at 160 r.p.m. with the shells touching, did the re-grinding instead of three 6-ft. Garfield Chilean mills. A comparative test was made to determine the respective merits of the re-grinders in these two sections with Huntington mills used in a third section. The following figures are interesting:

	Huntington mills	Rolls	Chilean mills
Ore treated per 24 hours, tons	741	519	421
Proportion reduced through 30-mesh, %	27.3	26.9	55.8
Ore reduced through 30-mesh, per 24 hr., tons	201	140	235
Power absorbed, hp	104	63	95
Ore reduced through 30-mesh per hp.-day, tons	1.93	2.22	2.47
Increase in −200-mesh material, %	7.4	10.1	16.6
−200-mesh material produced per day, tons	54.8	52.4	69.9
Ore reduced through 30-mesh while producing 1 ton of −200-mesh material, tons	3.69	2.67	3.36

Mr. Rogers comments as follows: "These figures show that the rolls produce more slime than the Chilean mills, a result that is entirely at variance with the usual conception. Calculations based on the third series of samples, however, show a similar result. It is possible that the method of driving the rolls, namely, by but one pulley, may account to some extent for this showing, and before reaching this conclusion fully, more tests should be made.

"It will also be noted from the figures that the Chilean mills show advantage in point of power absorbed, for they show the highest tonnage through 30-mesh per horsepower-day. In respect to repair cost on the different machines, no data exist regarding the rolls. Of the other two, the Huntington mills are more expansive to maintain while as between the Chilean mills and the rolls, the question can be determined only by keeping account of this cost over a long period, and this should be done. Altogether, as far as data go at present, the comparison results in favor of the Chilean mills."

The following statistics pertain to a 13-month period ending October 31, 1911:

Ore milled, tons	2,920,711
Average per day (396 days), tons	7,376
Proportion of total capacity operated, %	79.5
Power consumed per ton of ore, hp	0.47
Water consumed per ton of ore, tons	7.7
Ore concentrated per table (including vanners), per day, tons	10.05
Copper contained, per ton of ore, lb	35.9
Copper recovered, per ton of ore, lb	24.2
Average recovery of copper, %	67.48
Ratio of concentration	11.31
Number employees on operation	469
Number employees on repairs	141
Cost of milling, cents	45.2

ALTERATIONS IN THE PLANT. In 1915 the results in the mill were the best in the history of the plant up to this time. An important feature was the increased ratio of concentration which was 7.18 in 1915 as against 6.05 in 1914. This ratio had been gradually diminishing each year prior to 1915 partly because of the increasing proportion of pyrite in the ore being milled. The following figures show the average results obtained in the concentrator during 1915.

Ore milled (dry), tons	3,081,520
Assay of heads, copper, %	1.54
Extraction, copper, %	70.18
Ratio of concentration	7.18
Assay of heads, gold, oz	0.017
Assay of heads, silver, oz	0.042
Extraction, gold, %	49.47
Extraction, silver, %	51.34
Assay of concentrate, copper, %	7.77
Value of gold and silver recovered per ton, cents	18.56

During that year plans were made for, and work was started on, a number of alterations and additions to the plant and equipment for the purpose of obtaining added

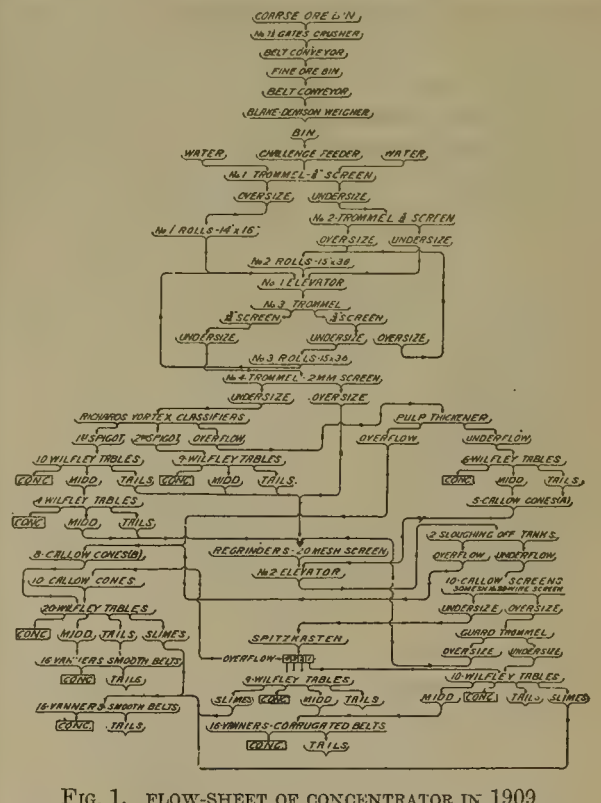


FIG. 1. FLOW-SHEET OF CONCENTRATOR IN 1909

capacity and increased efficiency. The most important measures were (1) the installation of double-decked concentrating tables to replace the old ones that had become overloaded, due to increased tonnage; (2) the substitution of tube-mills for Chilean and Huntington mills in the re-grinding department, thereby effecting economies in operation and adding to the capacity; (3) the construction of a new coarse-crushing plant.

The arrangement of the old crushing plant was unique; it has been the subject of much unfavorable criticism. It seems that when the mill was originally built the plan was to size the ore, in which there was a large proportion of fine material, at the mines; this, in fact, was done with the ore from the Veteran mine, but it was never found practicable for the steam-shovel ore.

The two sizes were to be shipped in separate standard railroad-cars to the concentrator; the cars carrying the finer material were to be dumped directly into the fine-ore bins that extend the full length of the plant on the uppermost terrace of the mill-site, leaving only the oversize mine-product to pass through the coarse-crushing department.

Having determined that the main railroad-track should surmount the ore-bin, it was necessary to provide an approach. Just why the entire plant could not have been moved a short distance to a more appropriate site does not seem clear; the fact remains, however, that the approach as constructed consisted of a huge double-track trestle, extending from the south end of the mill to an earthen abutment 1672 ft. distant. Of the total length, 460 ft. nearest the mill-building is of steel, and the remainder of wood, the maximum height being 109 ft. It cost $250,000. The steel portion supported the coarse-ore bin, beneath which was the coarse-crushing machinery, and the sampling-mill for the smelter. As a matter of fact the plan for sizing at the mine, in furtherance of which this trestle was built, was abandoned, but under any circumstances the decision to build the trestle seems to have been a serious engineering blunder.

Owing probably to the continued strain imposed by braking heavy trains, the structure was several inches out of plumb in 1915 and the wooden trestle was condemned as unsafe. It is now being torn down, the material providing excellent timber for the underground work in the Ruth mine. Although the crushing plant had successfully handled several times the quantity of ore for which it originally had been designed, a particularly large force of operators and mechanics was required to operate and maintain the machinery. Accordingly plans were made for an entirely new plant designed in accord with the most modern ideas and recent practice. It is well worth describing in some detail.

The New Crushing Plant. The bin is directly behind the mill-structure proper, the centre lines almost coinciding. The railroad track leaves the old line near the trestle abutment and follows the contour of the hill. A train of cars from the mine first passes over a Fairbanks standard track-scale equipped with a Streeter-Amet automatic weight-recorder. Each car in a train traveling at three miles per hour is weighed automatically and the weight stamped on a permanent record, with no chance for error through human fallibility. The train is then switched back to the return-side of a loop conveniently arranged, on a track surmounting the coarse-ore bin. This bin is 288 ft. long, 20 ft. wide, and 14 ft. deep, with a capacity of 5000 tons. On each side of the single track is a horizontal grizzley made of 70-lb. rail spaced 18 in. with the ball down. This leaves a 14-in. opening. Boulders that do not pass the grizzley are broken with hand-hammers or with dynamite. Inglesby side-dump railway cars, of 60-ton capacity, are dumped easily and are pronounced to be first-class in every way.

A novel feature is the use of compressed air to loosen the ore, which has a decided tendency to pack in the bin, owing to the clay-like character of much of the material. The discharge hoppers are in the centre of the bin, but so coherent is the ore, even when comparatively dry, that it forms almost vertical walls above the openings in the bottom. A great deal of work with bars and shovels has been avoided since the introduction of compressed-air pipes. Two-inch pipe-lines fitted with individual valves branch from a 6-in. header. The outlet of each is an open 45° L that looks downward and toward the centre of the bin at a point three feet above, and three feet back from, the discharge-opening. There are two rows of these, one along each side of the hoppers. It is astonishing how effectively the ore can be loosened by a short blast from one of these pipes. Previously 10 men per shift were required for this service.

The bottom of the bin, which is divided into two sections symmetrical about the centre line, is provided with 24 steel hoppers, directly beneath which are 24 steel apron-feeders 60 in. wide by 8 ft. 9 in. between the centres of head and tail sprocket-shafts. With the exception of one in each half, all the feeders point toward the centre line of the plant. The two excepted are placed back-to-back at the centre line, so that each faces the second feeder on its side. These four are high-speed feeders. The ten remaining in each half discharge onto a steel-pan conveyor, 60 in. wide and 118 ft. between head and tail sprocket-shafts. Each pan-conveyor discharges onto a traveling grizzley, 60 in. wide and 19 ft. 6 in. long, set transversely to the pan-conveyors. The grizzley-openings are about 3½ by 60 in. The two high-speed feeders in each half discharge directly onto their respective traveling grizzleys. The feeders are driven through bevel gears and eccentrics from line-shafts, at a speed of 2.5 ft. per minute, giving a maximum capacity of about 125 tons per feeder per hour. The individual feeders are controlled by separate pawls operated by the eccentrics. The four high-speed feeders have a capacity of 500 tons each per hour; accordingly it is possible when conditions are favorable, to dump all cars over the centre of the bin and to supply the entire plant by these four feeders, with the minimum movement of the ore, and use of machinery.

The oversize from each traveling grizzley (see accompanying illustration) is discharged to a No. 8 McCully gyratory crusher set to crush to about 3½ in. This makes a 4 to 1 reduction from the maximum oversize of 14 in. The crusher is driven by a 100-hp. motor at 425 r.p.m., direct-connected to the pinion-shaft of the crusher by a Nuttall flexible spring coupling. The pinion-shaft was cut off about 12 in. outside the main double bearing and no outboard bearing was used. This is thought to be the first time this plan has been tried, but no trouble has resulted. It saves belting and space, and is a measure for safety.

The discharge from the crushers joins the undersize from the traveling grizzley. This material is picked up on an incline belt-conveyor 42 in. wide, with 120-ft. centres, set at an angle of 19° 20′, and traveling 250 ft.

per minute. Each conveyor discharges onto a stationary inclined screen 6 ft. wide by 14 ft. long. The screen-frame is suspended over the undersize-chute on adjustable eye-bolts so that the most effective screening-angle can be obtained readily. There appears to be a critical angle for stationary screens, depending on the material screened and method of feeding. The oversize from each screen passes to a set of 72-in. by 20-in. Garfield rolls of the Alaskan type, having both drive-pulleys on the same side with an outboard bearing carrying the shaft-extension of the master roll. Each set of rolls is driven by belts from a line-shaft, which in turn is driven directly by a 150-hp. motor. The rolls are set to a ¾-in. opening, making a reduction of 4:1 from a maximum oversize screen. This procedure will take much of the burden from the ball-mills and will permit efficient grinding in a single stage. The accompanying drawing, Fig. 2, shows clearly the arrangement of the new equipment.

The two conveyors discharge the material at a point that is both the longitudinal and the transverse centre of the main fine-ore bins. From this point two horizontal tripper-conveyors distribute the ore to the storage-bins, which have a capacity of 30,000 tons. Prior to the remodeling of the plant about 16% of the material delivered to the storage-bins was coarser than ½ in., while 25% would pass a 48-mesh screen.

The total connected load is about 860 hp. With the exception of the feeders each machine in the plant is

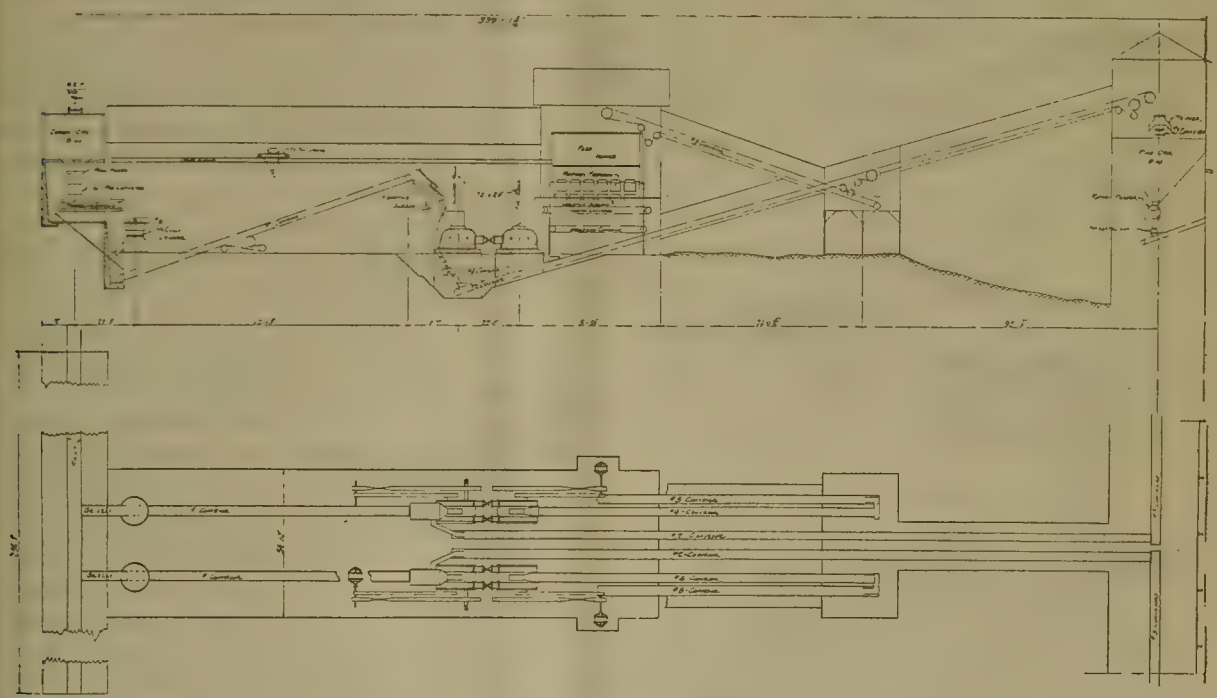


FIG. 2. PLAN AND SECTION OF THE COARSE-CRUSHING PLANT AS IT WILL BE WHEN ALTERATIONS HAVE BEEN COMPLETED

of 3½ in. The product from each set of rolls joins the undersize from its respective screen, and this material, the final product of the coarse-crushing plant, is carried by one of two inclined conveyors, 42 in. wide, with 270-ft. centres, set at an angle of about 16°, and running 275 ft. per minute. It is significant of the rapid progress being made in the art of ore-dressing that an important change is already under way in this plant, only about three years old. The stationary screens are to be supplemented by 6-mesh Mitchell vibrating screens. The oversize will be sent through the present rolls; this product will be screened on secondary Mitchell screens, the oversize from which will be re-crushed in a newly installed set of fine rolls. The product from this set will join the stream of ore to the first screen, while the undersize from both screens will go to the 270-ft. inclined conveyors, thus forming a closed circuit from which nothing escapes but material that has passed through a 6-mesh

driven by an individual motor. The first reduction, wherever gears enter into the driving mechanism, is made by belt or chain from the motor. Starting-boxes for all machines are set on either side of a control-booth from which an operator can see the entire plant. This booth is shown in one of the accompanying photographs. For emergencies two master-switches are provided in the booth, one for each half of the plant. These switches are cut into the main service-leads coming from the sub-station, so that power can be cut-off from the entire plant instantaneously. Each motor is provided with an overload relay and a low-voltage release. The design of the plant provides that each machine has a capacity slightly greater than that immediately preceding it. This allows the maximum feed without the possibility of chokes in the subsequent operations.

The plant is probably the first of its class in which material is elevated entirely by means of inclined belt-

conveyors to the complete exclusion of elevators. George C. Riser, superintendent of the concentrator, points out the following faults to be found with elevators: (1) The great expense of maintenance and renewal. In contrast the life of conveyors is exceptionally long. (2) The delay to operations. The clayey character of the ore is so

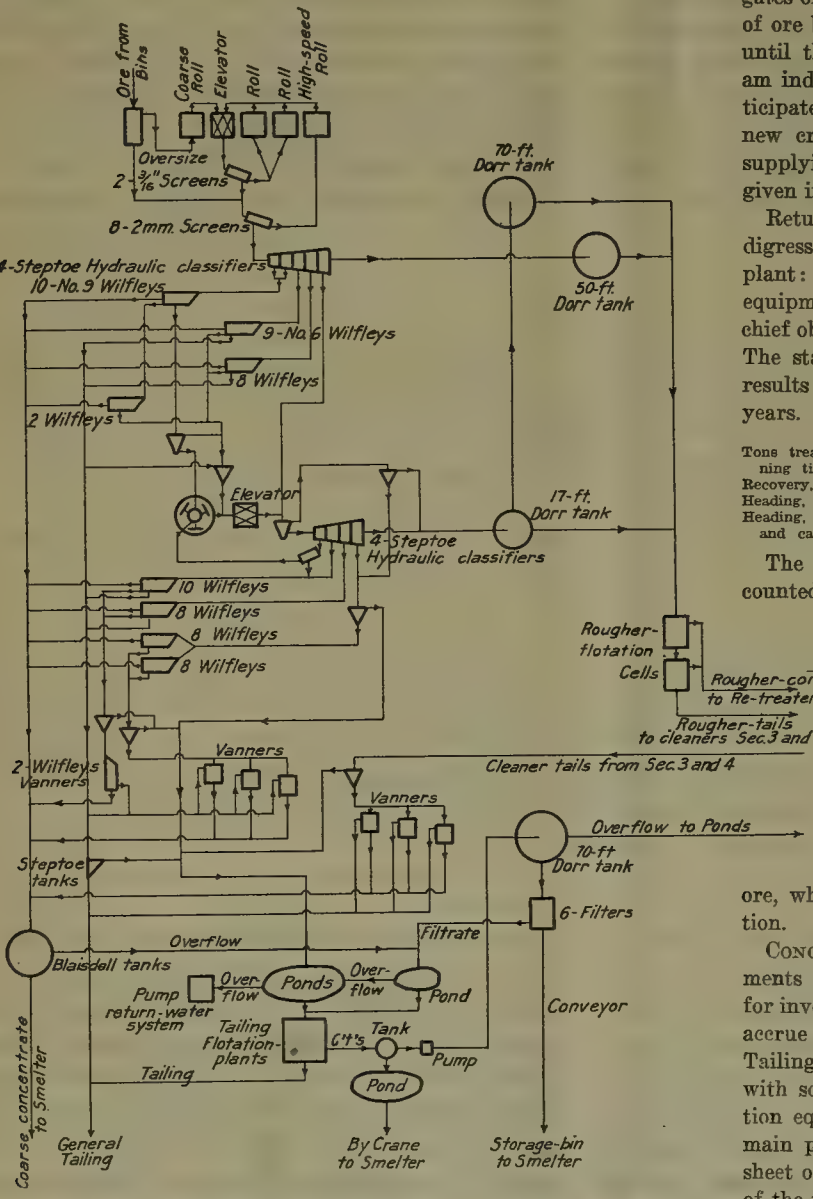


FIG. 3. FLOW-SHEET OF SECTION 7 IN 1919

pronounced that elevator-buckets cannot be kept clean. The ore accumulates in the buckets until the capacity of the elevator is reduced to the point where it must be shut-down. The time required to dig out the buckets may amount to hours, and may represent a large proportion of the possible operating time. The entire plant is designed to facilitate the handling of this sticky ore. The conveying equipment is supplied by the Stephens-Adamson company and is thoroughly standardized. All belts are 42 in. wide, of 8-ply construction, with a $\frac{1}{8}$-in. rubber surface. The idlers are troughed, with ball-bearings, while the return idlers are equipped with Hyatt roller-bearings. All chutes are made of sheet-steel and are lined with cast-iron or boiler-plate. There are no gates or chute-doors in the plant, the flow of ore being stopped by altering the slope until the angle of repose is reached. I am indebted to Curtis Lindley, who participated in the design and erection of the new crushing-plant, for his kindness in supplying me with many of the details given in this description.

Returning to the point from which I digressed to describe the new crushing-plant: The various changes made in the equipment and flow-sheet have for their chief object an increase in tonnage treated. The statistics that follow summarize the results obtained during the period of three years.

	1916	1917	1918
Tons treated per day (running time)	11,531	12,663	13,051
Recovery, %	73.87	73.08	67.28
Heading, copper, %	1.63	1.46	1.50
Heading, copper, %, as oxide and carbonate	0.13	0.14	0.17

The decrease in recovery in 1918 is accounted for principally by the inability to obtain competent and experienced mill-operators; government service during the War drew heavily upon the personnel of the organization. Another factor was an increase in the proportion of oxide and carbonate copper compounds in the ore, which militated against high extraction.

CONCENTRATION BY FLOTATION. Experiments had been in progress since 1914 for investigating the advantage that might accrue from the use of froth-flotation. Tailing from the vanners had been floated with some recovery of copper, and flotation equipment had been installed in the main plant. In Fig. 3 is seen the flow-sheet of Section 7 in 1919; this is typical of the treatment, used prior to the recent shut-down, in the sections that are not yet remodeled. This shows the flotation of the slime overflow from the Steptoe classifiers and of a portion of the vanner tailings, but the general principles of the 'Steptoe' flow-sheet survive. For the most part, however, the results of flotation were unsatisfactory, especially on the mixed ore. The high content of alumina (about 14%) was detrimental, as was also the presence of oxidized minerals. However, in 1919, after the discovery of 'xylidine' as a solvent for 'X-

cake', a scheme of treatment was developed that far surpassed any results obtained prior to that time. After exhaustive experimental work, plans were completed for the remodeling of Section 3 with flotation as the essential step in concentration. A second design was developed for Section 4; the difference is that here table-concentration of the 6-mesh ore precedes ball-mill grinding for flotation.

At the time the plant was shut-down, on April 2, 1921, Section 3 and three-fourths of Section 4 were remodeled and in operation; I shall first describe briefly the treatment as practised in Section 3. The original fine-ore bin had a flat bottom 30 ft. 6 in. from front to back, the ore passed through hand-operated basket-gates onto a conveyor, which discharged into a small auxiliary bin, from which it was supplied to the rolls by Challenge feeders. In remodeling this section a steeply pitched hoppered bottom has been constructed to replace the old bin-floor and a series of rotary feeders, one for each ball-mill, has been installed. The rotary feeder is a pulley 5 ft. in diam. with a 36-in. face, operated by a dog connected with an eccentric. A rack-and-pinion gate provides for the adjustment of the aperture above the face of the pulley, through which the ore flows. Compressed-air pipes similar to those used in the receiving-bins of the coarse-crushing plant have been provided to facilitate the constant flow of the ore.

In Section 3, ore from the fine-ore bin is fed directly to 30-in. by 8-ft. Hardinge ball-mills, driven through herringbone gears by 125-hp. motors, and arranged in closed circuit with 6-ft. Dorr duplex classifiers. The Hardinge mills are fed with 3-in. balls, cast in the plant foundry; each grinds 450 to 500 tons per day and supplies three rows of flotation-cells. The flotation feed, overflowing from the classifier, passes through a punched screen for the removal of wood-pulp and other debris. A simple detail, but one that has an important bearing on the efficiency of flotation, is the inclining of these screens to an almost horizontal, instead of a vertical, position. The result is a constantly uniform feed instead of a periodical deluge, which would otherwise follow when the operator cleaned the screen. Uniformity of feed is essential to good flotation.

The rougher-cell is a trough, 30 in. wide and 20 ft. long, with the bottom sloping ½ in. per foot. These are arranged in pairs with a common launder running lengthwise between the two, and with an additional launder on the outer side of each, to receive the froth. The accompanying illustration gives a good idea of the general appearance of the cells. The bottom of the cells is fitted with filter-mats, 15 in. by 30 in., composed of a cast-iron pan covered with four-ply twill furnished by the Filter Fabrics Co. Individual air-pipes extend from the six-inch header placed at a convenient distance above the cell, through the pulp to the mats, where connection is made by a special lock-nut. The air-pressure is usually maintained at 5 lb. per sq. in., while the dilution of the pulp is approximately 3:1, water to solid. The pulp-level is regulated by a weir-overflow at the effluent end of the cell where a vertical baffle prevents the froth from escaping. Froth from the roughers is re-floated in a cleaner of the same design.

The concentrate from the cleaners flows to three 60-ft. Dorr thickening-tanks. The underflow, having a consistence of 1¼:1, water to solid, is filtered by four Oliver and two Portland filters, all 12 ft. by 12 ft., producing a cake averaging 15% moisture.

The flotation tailing is concentrated on No. 5 Wilfley tables. The table-concentrate joins that from the flotation-cells as it enters the thickener. Being somewhat coarser than the froth-concentrate and having been freed of any coating of oil, it hastens the settling and permits a thicker pulp to be drawn off than otherwise would be possible. It is likewise beneficial in filtering; it makes the cake more porous, and therefore dryer.

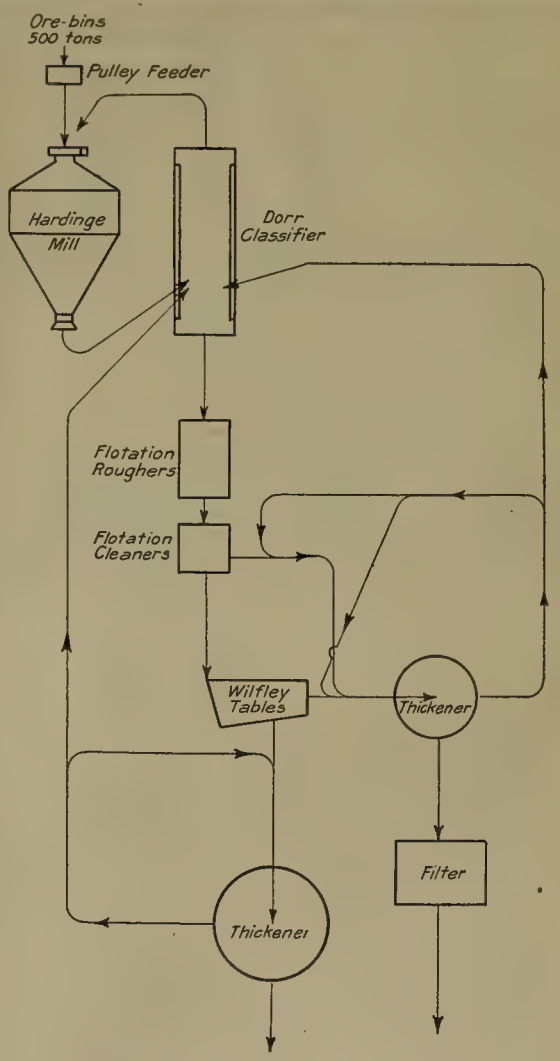


FIG. 4. PRESENT FLOW-SHEET OF SECTION 3

It may be noted that the return water from the thickener and filter is sent directly to the classifier instead of being used to wet the feed to the ball-mill. Another in-

teresting point is the feeding of all flotative reagents through a small pipe that extends several inches beneath the quiet surface of the pulp at the head of the rougher-cell, where the first mat has been removed so that there is no agitation whatever at the point where the reagents are introduced. This procedure is possible because of the solubility of the flotative reagents.

Section 4 differs from No. 3 in several respects, as may be seen by examining the accompanying flow-sheets (Fig. 4 and 5). The ore from the fine bins, all of which hereafter will have been crushed to pass a 6-mesh screen in the coarse-crushing plant, will go directly to Garfield tables; the product will be cleaned on No. 5 Wilfleys; and the tailing will flow to four Dorr classifiers, the sand from which will feed four cylindrical ball-mills, the overflow going to the flotation department. The remaining treatment will be the same as Section 3.

It will be observed that a comparatively coarse table-concentrate is prepared in this section. One important reason for this provision is the desirability of supplying the smelter with a certain proportion of coarse concentrate. While it is true that this rougher table-concentrate has a higher iron content and is lower in copper than that obtained from flotation, this disadvantage is more than offset by the simplified handling in the roasters at the smelter. This will be mentioned in a subsequent article describing the smelting operations.

An interesting innovation is a filtering or dewatering arrangement on the classifiers. The coarse concentrate from the primary tables goes to a specially built Dorr machine, the inclined floor of which, above the water-level, is provided with a filter-bottom covered with a bed of coarse concentrate, 4 in. thick. Beneath is a chamber connected with a vacuum-pump; the suction removes most of the water as the concentrate is advanced by the rakes. The dewatered product falls onto horizontal belt-conveyors, which discharge into standard-gauge cars on the same track as those that receive the cake from the Oliver filters. The overflow goes to the thickeners that receive the flotation, and secondary-table, concentrates. One feature of the treatment in both of these sections is its extreme simplicity. When adjustments are once made the minimum of attention by the millman is necessary, the entire operation being as nearly automatic as possible. One of Mr. Riser's theories is that simplicity is synonymous with efficiency and economy.

Table I—Results Obtained in the Remodeled Sections During Early Part of 1921

Month	Tons milled	Heading Copper, %	Concentrate Copper, %	Concentrate Insoluble, %	Concentrate Iron, %	Tailing Copper, %	Copper in form of oxide and carbonate Heading, %	Copper in form of oxide and carbonate Tailing, %	Ratio of concentration, %	Indicated extraction, %
January	100,566	1.566	10.45	28.8	23.9	0.364	0.13	0.04	8.4	79.4
February	119,547	1.472	11.96	30.0	23.5	0.284	0.13	0.02	9.8	82.7
March	124,483	1.472	14.88	25.1	24.6	0.280	0.06	0.03	12.3	82.7
April	7,176	1.506	13.46	...	...	0.292	...	...	10.8	82.3
Average	351,802	1.499	12.59	27.3	23.5	0.306	0.10	0.03	10.3	81.6

The accompanying tables show the results obtained in the remodeled sections of the mill during 1921 prior to the shut-down in April. Table I gives details and averages for the first four months, whereas the others deal with the month of March only.

The following figures, comparing the work done in 1911, 1915, and 1921, are typical of three different periods in the history of operations.

Year	Mill heading, copper, %	Ratio of concentration	Concentrate, copper, %	Extraction, %
1911	1.79	11.31	14.2	67.48
1915	1.54	7.18	7.77	70.18
1921	1.49	10.3	12.59	81.6

The most significant feature is the combination of high extraction, high ratio of concentration, and the production of high-grade concentrate in 1921. Ten years before it was the practice to maintain the grade of the concentrate and the ratio of concentration at the expense of good recovery; in 1915 the concentrating ratio and the grade of the product were sacrificed to get a higher extraction from ore that was not only leaner in copper but less desirable because of the higher proportion of pyrite and oxidized copper minerals in its composition. The ore being milled today differs but little from that of 1915; but improved methods of concentration, including flotation with soluble frothing reagents, has made better results possible.

Table II—Composite Analyses—Month of March 1921

	Gold, oz.	Silver, oz.	Copper, %	Silica, %	Iron, %	Lime, %	Alumina, %	Sulphur, %	Copper in form of oxide and carbonate, %
Heading	0.015	0.055	1.472	67.2	3.9	0.5	10.6	3.2	0.10
Total concentrate	0.106	0.372	14.880	20.0	24.6	0.2	5.1	29.0	0.34
Final tailing	0.005	0.027	0.280	71.6	2.0	..	14.6	0.86	0.03

Table III—Screen Analyses—Month of March 1921

Mesh	Flotation concentrate Weight, %	Flotation concentrate Copper, %	Flotation concentrate Per cent of total	Table-concentrate Weight, %	Table-concentrate Copper, %	Table-concentrate Per cent of total	Final tailing Weight, %	Final tailing Copper, %	Final tailing Per cent of total
+ 20	..	....	..	0.2	....	...	...	....	...
28	..	....	..	0.2	....	...	0.2	....	...
35	1.4	....	..	1.0	....	...	6.0	0.446	8.9
48	1.0	2.31	0.3	8.4	12.36	12.7	10.8	0.319	11.0
65	2.4	14.12	2.0	26.0	11.51	31.3	11.2	0.315	11.3
100	13.2	20.59	16.0	31.4	9.16	30.1	13.0	0.311	12.9
150	11.4	22.25	14.9	16.8	8.99	15.8	10.0	0.302	9.7
200	5.6	22.48	7.4	5.4	6.81	3.8	4.8	0.302	4.6
−200	65.0	15.47	59.4	10.6	5.67	6.3	44.0	0.294	41.6
	100.0	16.96	100.0	100.0	9.55	100.0	100.0	0.312	100.0

Table IV—Cost per Ton During March 1921

Unloading ore	$0.016
Fine-ore bins	0.008
Flotation	0.116
Flotation reagents	0.164
Concentrate cleaning system	0.028
Sampling	0.009
Thickening and filtering	0.006
Excavator, Blaisdell	0.005
General mill	0.047
Coarse-crushing	0.053
Power	0.095
Power (air for flotation)	0.062
Water service	0.035
Gravity-system operation	0.058
Transportation of concentrate	0.022
General expense	0.119
Total milling cost	$0.843

Minerals Separation North American Corporation has pending at this time two suits for alleged infringement of its flotation patents. The first brought on September 9, 1919, is based on patent No. 835,120, the one on which the Butte & Superior company has been found guilty of infringement; the second brought on February 16, 1920, is based on the 'soluble frothing-agent' patent, No. 962,678. The defendant in each case questions the validity of the patent and denies infringement. Neither suit has yet come to trial. As T. A. Rickard* pertinently observes:

"It is interesting to note that in these Nevada cases the plaintiff is claiming that pine-oil has certain soluble fractions, and that the use of pine-oil constitutes an infringement of both patents, 835,120 and 962,678. It remains to be seen how Minerals Separation will square its present position with the testimony in the Miami case, wherein its expert, Dr. Leibmann, said that pine-oil, for all practical purposes, was insoluble, and it remains also to be seen how Minerals Separation will deal with the Supreme Court's decision in the Butte case where it was held that pine-oil was 'an oil having a preferential affinity for metalliferous matter' within the description of patent 835,120. The legal definition of 'solubility' will be awaited with interest, likewise the juridical effort to distinguish between the use of the term in chemistry and in metallurgy respectively."

The problem that remained unsolved for a long time was to find a reagent that would successfully float the 'rusty' chalcocite ore as well as the great variety of ore found in the steam-shovel mine. The results of concentration were erratic until the mixture of X-cake and xylidine was adopted. One-third of a pound of a mixture composed of 60% X-cake and 40% xylidine is used regularly. X-cake is a trade name for alpho-naphthylamine, one of the many products derived from coal-tar. Its principal function in flotation is that of a selective agent, but it has, as well, slight frothing properties. Xylidine is also a coal-tar product and is used in the mixture as a solvent for the alpha-naphthylamine, and as frother. An alternative combination is thio-carbonilide with ortho-toluidine as a solvent, and aldol or fizzol, as the frother. This mixture gives results equally as good; the reagents are cheaper and they will doubtless be used when operations are resumed.

The fact that the reagents are soluble is probably responsible for the use of pneumatic flotation-cells in preference to machines depending upon mechanical agitation. Mechanical agitation offers no advantages and since power is comparatively expensive at McGill the element of cost favors the use of 'air' cells.

It is necessary to maintain an alkaline circuit, for which purpose a thin emulsion of lime is introduced into the ball-mills. This is prepared in a small separate plant consisting of a jaw-crusher, a 30-in. by 8-ft. Hardinge mill, and a 56-ft. Dorr tank, the underflow from which goes to the flotation plant to provide the necessary alkalinity. The lime precipitates the ferric salts, which are believed to interfere with frothing, when X-cake and xylidine are used.

Just below the mill is the plant for pumping the water reclaimed from the tailings; here a large Nordberg high-efficiency steam-pump is installed. This machine was originally erected at Garfield, Utah, but was moved to McGill in 1918. The steam end is a horizontal triple-expansion engine. The valve-gear is controlled by a

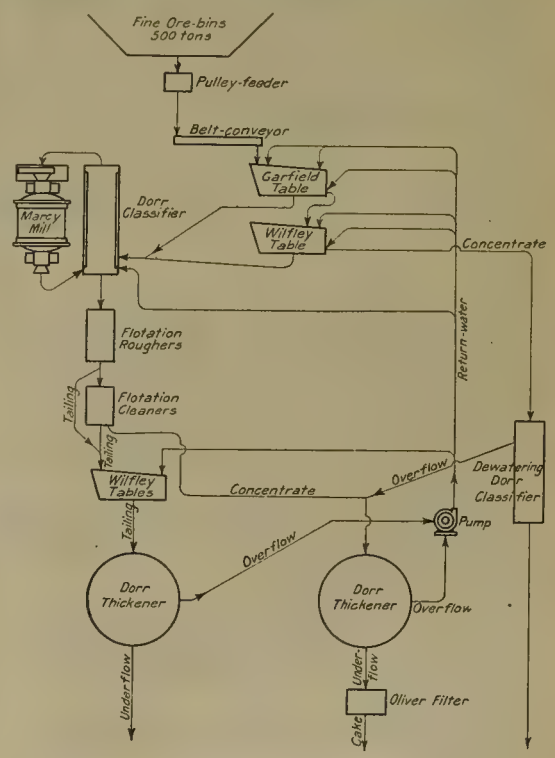


FIG. 5. PRESENT FLOW-SHEET OF SECTION 4

Nordberg static governor whereby the speed may be reduced to 12 or 15 r.p.m. without sacrificing efficiency in any degree. The steam-cylinders are 22, 42, and 60 in. diam. respectively with a 52-inch stroke, and are jacketed to economize steam. The engine was designed to deliver a maximum of 10,000 gal. per min. against a head of 256 ft. with steam at 160 lb. It is not called upon to meet these specifications at McGill, but a feature of the machine is its ability to operate efficiently even when doing only a small part of its rated performance.

*'Present Status of Flotation Litigation', by T. A. Rickard, 'M. & S. P.', January 22, 1921.

Licensing of Engineers

The following is the report of the committee appointed by the Mining and Metallurgical Society of America to consider the question of licensing engineers:

August 11, 1921.

To the Members of the Council
M. M. S. A.

Dear Sirs:

In accordance with the instructions which your Committee on Licensing of Mining Engineers received from President Spurr, we beg to submit to you the following report.

128 letters have been received in response to the letter of the President asking for an expression of opinion. The responses have been classified as follows:

"A"—Unconditionally opposed	81
"B"—Opposed on general principles but would favor uniform State laws with reciprocity or general Federal law	12
"C"—Opposed, but would accept licensing as a matter of expediency and would join in attempting to steer legislation	4
Total opposed	97
"D"—In favor, conditionally	16
"E"—In favor, unconditionally	5
Total in favor	21
"F"—Doubtful	8
"G"—No opinion	2
	10

The difference between B and C and D is that B and C are opposed on principle while D favor the principle but wish to avoid the annoyance and expense entailed in individual State licenses.

These unconditionally in favor of licensing base their attitude on the desire for higher professional standing and better protection of the public.

Obviously, however, these are matters as to which those of the opposition are equally concerned, even though their solicitude may not be voiced, or may be but inferentially or negatively expressed.

It is also to be observed that those conditionally favorable must be considered as virtually of the opposition, in view of the weight of negative opinion bearing on the conditions stipulated.

Briefly, the point of view of this opposition is to the following effect:

Licensing would neither improve nor safeguard professional standing, partly because professional qualifications could not be adequately formulated in such a law, and partly because of probable miscarriage in its administration.

In determining professional qualifications it is necessary to take into account, not only the technical ability called for by the work in contemplation, but also character and the lay attributes required of the engineer in that connection. Often, technical ability is secondary to the other factors, and the matter of qualifications a question of something inherent or earnest rather than of something acquired—something that no conceivable licensing system could measure.

Administration would not only be confronted with difficulties, due to the considerations just mentioned, but, in all probability, would suffer from the play of politics, as well as from undue regard for local interest.

Consequently, it is widely held that licensing would be of no real advantage to the profession; that, even with State reciprocity, it would involve useless expense and hardship; and that it could not possibly result in the exclusion of the unfit. Some, indeed, are of the opinion that licensing would afford cover to the unfit and thereby tend to lower the standing of the profession.

The maintenance of professional standards is regarded as essentially a professional matter, although it is recognized that a strong incentive to excellence is provided by the discernment of employers and clients.

The position of the public in relation to the question of licensing is discussed from the standpoint of employers, as well as investors, in the replies.

Employees are considered to be already protected, or in the way of being protected by legislation applying to those directly responsible. Whether Mine Managers should be regarded as sharing responsibility, and be required to qualify by examination for a license, as in South Africa, is not, as a rule, touched on. It may be observed in this connection, however, that, even in South Africa, licensing does not extend to Consulting Engineers.

Investors are believed to be as well protected as possible and more liable to suffer than to benefit through licensing. Their position is different from that of the general public in relation to the other professions, for their transactions are not of such urgency as to preclude inquiry and verification, the means for which are ample. Licensing would not relieve them of the need for precaution, since, as already stated, it would not eliminate the unfit from the profession, although, it might, in some instances, give rise to a false sense of security and thus obscure that need.

W. L. Honnold, Chairman
H. G. Moulton
J. V. Lewis
A. M. Smoot
F. F. Sharpless.

A method has been successfully tried for rendering aluminum and its alloys proof against rust, according to a writer in 'Industrial Engineering'. An electrolyte is made up of a sulphur compound of molybdenum and zinc employed as the anode, constituting a cell with the aluminum as cathode. By maintaining the cell at a temperature of from 60° to 65° the aluminum becomes covered with a dark brown coating which proves adhesive and rust-proof against the most stringent tests. The metal may be bent or rolled without cracking the coating, and has been immersed by way of test in a salt solution for two months without showing a trace of corrosion.

The Magmatic Origin of the Chalcopyrite and Bornite at Engels

The Editor:

Sir—In the article on the Engels mine by Mr. A. B. Parsons, in your issue of July 30, there appears a reference to a paper by H. W. Turner and A. P. Rogers on the ores of that mine, and subsequent articles written by L. C. Graton and R. P. McLaughlin. Mr. Parsons draws the inference that the conclusions of Turner and Rogers are wrong whereas Graton and McLaughlin are correct, referring especially to the formation of copper glance, or chalcocite, which in most copper deposits is undoubtedly a product of downward sulphide enrichment. A discussion of this matter requires the production of a mass of scientific data, which can only be digested by expert petrographers and metallographers. It is not the purpose of this letter to discuss the occurrence of chalcocite at the upper Engels mine, as it is of minor importance, and according to Mr. Parsons, chalcocite ore has given out in the lower levels of the main orebody. Suffice it to say that in most copper deposits where glance is an important constituent of the ore, pyrite is usually present. This mineral readily oxidizes, forming, as one result of the reactions, sulphuric acid, which leaches out the copper and silver of the ore and carries these metals in solution to lower levels, where they are precipitated forming the well-known zones of sulphide enrichment. Chalcopyrite and bornite oxidize less readily, and hence supply less acid. There are three reasons why no such strong zone of sulphide enrichment exists in the upper Engels mine:

(1) The absence of pyrite as noted above and hence the lack of abundant acid to leach out the metals and carry them to lower levels.

(2) The density of the orebearing rock making it difficult for the descending solutions to penetrate it.

(3) The lack of strong shearing or fissuring, so that spaces for downward percolation of waters were largely lacking.

For these reasons, the amount of secondary chalcocite in the Engels deposit is insignificant compared with its occurrence in many other copper deposits. It is probably safe to say that 95% or more of the copper produced at the Engels mine comes from bornite and chalcopyrite. These two minerals form the 'bread and butter' of the mine, and it is therefore of great scientific and economic interest to determine if the chalcopyrite and bornite are of magmatic or hydrothermal origin. If of magmatic origin it is very likely that the deposit may extend to a considerable depth and if one ore lens gives out it may be replaced below by another lens as in the similar Twee fontein mine in Africa. If of hydrothermal origin, it is probable that the ores will give out at a comparatively shallow depth, for the reason that there is no strong fissuring or shearing at the Engels deposit such as occurs at all deep sulphide metal mines of hydrothermal origin.

To discuss the origin of the ore, it might be well to define magmatic and hydrothermal deposits, although in nature there may be, and probably is, a gradation from one to the other. Most mining geologists of the present day including, I presume, Messrs. Graton and McLaughlin, ascribe nearly all metalliferous deposits, such as the copper, gold, and silver mines of the Western States, to magmatic waters arising from a magma in depth and depositing their valuable contents in fissures and in adjoining wall-rocks comparatively near the surface. Such deposits, however, would be called hydrothermal, since water is the chief agency in transporting the metals from depth to the veins where we now find them, and frequently (as in the Mother Lode gold belt) the veins are not in the igneous rock from which the metals came, but in older sedimentary or schistose rocks.

Magmatic deposits, on the other hand, may be designated as deposits originating in the magma in which we find them without being transported any great distance through fissures, sheared zones, or porous rocks. All magmas contain water, which in the gaseous form is a mineralizer; and other mineralizers may be present and active, and yet if the ores are deposited at their place of origin or nearly so, the ores being original in the magma, it will be perfectly proper to designate the deposit as one of magmatic origin, even though modified and rearranged by pneumatolytic or hydrothermal agencies, in contradistinction to one of plainly hydrothermal origin in which the metals are brought from remote sources by ascending waters. This definition will probably suit neither Tolman and Rogers nor Graton and McLaughlin, but is here used to emphasize the great difference between a deposit like that of the upper Engels mine where the ore-minerals occur in a fresh massive dioritic rock, and one, say, like the Butte deposits, which clearly occur along fissures extending to great depth.

Moreover, in the last analysis, if the present prevalent theory that nearly all gold-silver-copper deposits containing sulphides owe their origin to waters originating in magmas, all such deposits are in a broad way magmatic; but for practical purposes can readily be separated into two series:

(1) Hydrothermal: those in which the metals have been transported a considerable distance.

(2) Magmatic: those in which the metals and sulphides originally crystallized out in the parent rock at or nearly at the points where we now find them.

At one extreme we have the Butte copper veins, the gold veins of the Mother Lode, the silver veins of Tonopah, etc.; and at the other extreme, deposits like that of the Engels mine, the famous Sudbury pyrrhotite-nickel deposits, and the copper deposits of Namaqualand in South-West Africa.

The only expert petrographers and metallographers that have studied the Engels deposit, so far as I know, are Tolman and Rogers of Stanford University and Graton and McLaughlin. The original paper by Turner and Rogers has already been referred to. But at a later date Professors Tolman and Rogers obtained suites of specimens of ores from many other magmatic deposits and spent a year or more in carefully investigating them. This research work was published in a bulletin of Stanford University in 1916 and forms the best general review of the whole subject of magmatic deposits that has appeared in recent years. However, it is not referred to in the paper by Graton and McLaughlin published at a later date in 1917, in 'Economic Geology'.*

If now we take the papers published by the experts above referred to, we may note that they do not greatly differ concerning some of the main features of the origin of the chalcopyrite-bornite orebodies; and this is the only matter of practical importance in the discussion. Both consider that the ore was deposited after the silicates. Tolman and Rogers consider this to have occurred soon after the crystallization of the silicates, chiefly by the action of mineralizers (pneumatolytic) with some later hydrothermal action. Graton and McLaughlin divide the various processes, resulting in the formation of the ore, into four divisions, but state that these "four stages covering the time from initial magmatic conditions to the close of the primary mineralization, are merely convenient divisions of an uninterrupted sequence", and further state that "the orebody is in our opinion a direct result of igneous action; but was formed as a final concentration following the crystallization of the rock and not as a magmatic segregation".

If one may criticize the papers by Graton and McLaughlin, it may be said that as a whole they give the impression that the orebearing diorite of the Engels mine is a much altered rock, whereas from a petrographic standpoint it is usually quite fresh. By over-emphasizing what they consider evidences of hydrothermal action, one would draw the conclusion that the deposit is similar to the typical hydrothermal deposits as understood by mining geologists in general. A careful reading of their conclusions, however, suggests that that is not their meaning, but that it is a direct result of igneous action and not brought up from unknown sources. It may also be said that under the head of Intense Hydrothermal Period they emphasize the formation of chlorite, sericite, and epidote, as evidence of strong hydrothermal action. As a matter of fact these minerals, especially chlorite and sericite, are common throughout the Sierra Nevada granitic rocks, the sericite being derived largely from feldspar and the chlorite from biotite. An absolutely fresh granitic rock is a rarity anywhere in the world, as any competent petrographer will testify. Absolutely fresh granitic rocks are certainly rare in the Sierra Nevada and the sericite, chlorite, and epidote in them are no doubt the product of hydro-metamorphism, which implies hydrothermal action. It in no sense implies such *intense* hydrothermal action as is seen in vein deposits in general. On the contrary, it implies mild hydrothermal action. Otherwise we must regard the great granite batholith of the Sierra Nevada as having been subjected to intense hydrothermal action at many places.

In reference to the Superior deposit, also in a granular igneous rock (a form of grano-diorite), the statement is made that pyrite is absent. This may be true of the ore itself, but it is not true of the grano-diorite country-rock, as may be seen in the original lower Superior tunnel, where pyrite coats the joint-planes.

The stockholders of the Engels mine probably do not care what the origin of their copper ore is, so long as it is of commercial value and continues in depth or laterally; they are interested in the matter to this extent, however, that if the deposit is of magmatic origin, taking my rather wide definition of that term, they may be assured that the present ore lenses may extend to a considerable depth, and that other similar lenses may be found. If, on the other hand, it is of hydrothermal origin, as the term is usually used, the ores must soon give out, as the dense nature of the rock and the lack of shearing or fissuring, militate against a vigorous circulation of ascending waters.

H. W. Turner.

San Francisco, August 12.

*In a later paper dealing chiefly with the formation of chalcocite, Graton and McLaughlin refer in a complimentary manner to the excellent bulletin by Tolman and Rogers and modify their views in some details, none of which are of importance as related to the main theme of this article, namely to emphasize the great difference between an ordinary hydrothermal deposit and that of the Engels mine.

The Tariff on Magnesite and Chrome

The Editor:

Sir—I am reliably informed by letter from Washington that the Fordney tariff bill now pending in the Senate, and which passed the House on July 31, provides a tariff on magnesite of $10 per ton, and places chrome on the free list. Both of these minerals are extensively used in the manufacture of steel, magnesite and chrome being used practically for the same purpose of making firebrick for use in melting-furnaces.

If the object of the Fordney bill is to give protection to the miners of magnesite and chrome, and to discourage the importation of these minerals from foreign countries, then this bill, if passed in its present form, will prove a fraud and a failure, for it is very evidently written to protect the interests of the steel manufacturers, who

desire to import these minerals as cheaply as possible from foreign countries. With chrome on the free list, the steel manufacturers will not need to buy any magnesite, but will use imported chrome exclusively.

I am advised that the collection of private individuals who call themselves the American Mining Congress is against a tariff on chrome. If this is true, they are not supporting the interests of American miners, but are under the control of the steel manufacturers of the United States.

An adequate protection duty on magnesite should be $15 per ton, and this would not be effective unless a similar duty was placed on chrome, because the two minerals are chiefly used for the same purpose. An adequate protective tariff on both minerals above mentioned would give employment to thousands of miners on the Pacific Coast, where numerous mines producing these minerals are located which cannot now be worked because of the lack of a market.

Every person who favors a protective tariff on these minerals should write letters to Senator Hiram Johnson, Senator Samuel M. Shortridge, and other Pacific Coast Senators at Washington, asking that the tariff bill now before the Senate be amended to give adequate protection to the American producers of these minerals.

W. S. CRANMER.

Berkeley, California, August 17.

Placers in Sinaloa

The Editor:

Sir—Relative to your editorial comment of July 30 on the story published in the San Francisco 'Examiner' concerning "Sinaloa placer deposits so rich as to tax human credulity", may I add to your very pertinent and truthful remarks that the reading of the same 'Examiner' story down here in Mexico, where all this wealth is imagined to exist, has afforded old-timers more genuine opportunity for expression through means of side-splitting guffaws than any story which has appeared for some time.

According to a level-headed mining engineer who has resided in Sinaloa for the past twenty years and who has been keeping his eyes peeled during all that period for just the thing mentioned as so abundant—namely gold, it is true engineers from somewhere have been engaged in spending money and enjoying the native delights for some time in the regions mentioned along the Yaqui, Mayo, Fuerte, and Sinaloa rivers. But if said investigators are so tender-footed or soft-headed as to imagine that the native Mexican has overlooked any easy placer pickings, he has something of a jolt coming around the corner. Nor has the lynx-eyed Americano or other foreign mining engineer been so ruthless as to tread four-pound nuggets under-foot for the past generation or two where anything like exploitation by modern engineering would pay.

I have just returned from spending a brief vacation on the Fuerte river, in Sinaloa, and while I admit that the doves, quails, and cotton-tail rabbits are considerably thicker than hair on a Mexican poodle, yet my instinct to pan a few colors of the good old yellow metal along the banks of the river were rewarded with many drops of perspiration. Evidently the Aztecs had cleaned up all the coarse gold several centuries ago. Only the finest colors of alluvial gold were obtained in my pan, and the Mexican residents of that part of the world were engaged in every other painstaking occupation other than gold-placering.

Would you be terribly shocked to be informed that the 'Examiner' or other Hearst publications are barred from this section of Mexico and can't be bought locally for love or money. It's strange, but true.

ALBERT E. MAAS.

Guaymas, Mexico, August 15.

[We envy the people of Sonora in so far as they are spared the affliction that weighs so heavily on the people of San Francisco. In regard to the main subject of our correspondent's letter, we may mention that we have received other letters to the same effect. One writer says that he is well acquainted with the placer ground along the Sinaloa river, where the richest claims are supposed to be located. The region has been worked by the natives for a hundred years and still yields them a precarious living by the aid of simple methods of mining, but the gravel is so poor that no white man can compete with them. If Mr. Van der Naillen has evidence of the richness of the ground, we shall be glad to hear from him, for we are ready to believe that the absurd character of the article in the 'Examiner' may be due to the ignorance of the reporter who interviewed him and not to recklessness of statement on his own part. If he had a story of genuine discovery to give to the public in this community, he should have sent it to a reputable paper.—EDITOR.]

Indexing Current Technical Literature

The Editor:

Sir—Your editorial. in the issue of August 6, upon 'Indexing Current Technical Literature', prompts the following suggestion: that the current form of presenting the notices of technical articles in the monthly magazine of the Institute could be changed to good effect and advantage to all members, at but a small cost, upon the following lines:

Why not publish the service for distribution upon a card, so that the information can be filed monthly by recipients, and thus be classified and made more readily available. Specialization in the ranks of our members has become so intensive that what interests the coal-mining engineer does not necessarily interest the metal-mining man, nor does the class of papers which interests either of them meet the needs of the engineer wholly engrossed in petroleum mining.

If the Institute will classify this indexing work on some broad lines, each member can subscribe to the particular sections in which he is interested, and have sent him each month either his own particular index-cards,

or all of them that are published, if he so desires. I am in thorough accord with the idea of providing a monthly service of the character now presented, and now that the service is established it should be expanded to its highest usefulness. None will object to the slight additional expense for the more convenient record of the data in which he may be interested.

J. H. G. WOLF.

San Francisco, August 16.

Revision of the Mining Law

The Editor:

Sir—In your issue of June 18 you printed a full text of the proposed mining law, as revised from the old. You also have an editorial bearing somewhat on the subject, reminding your readers that the main desire of a new law was to eliminate the extra-lateral right. You also gave us a history of the efforts which led to the construction of the present law. The Chicago 'Mining World' had started a campaign for the purpose of arousing the mining public and obtain the views of interested parties, some of which might convey valuable information that might be fused on the new law. Many suggestions were received by the same paper. Some showed a keen practical understanding of the business; others were dreams; some were absurd. We even could find often a flavoring of Government ownership. The reader could easily distinguish the parties who had never been affiliated with the game. They might have read of wild-cats, of rich strikes bringing sudden wealth, but had never read of the struggles. The agitation at the time was for the purpose of finding a solution which would put an end to that everlasting litigation, proving a ruination to the parties interested therein, to the locality, as well as casting an aspersion on the industry.

Of all remedies only one solution appeared practical, to wit: the enlarging of claims and confining the owner or owners to vertical planes of his surface boundaries. This proposed new law disposes of the extra-lateral in a very few words, but elaborates on so many different changes that the reader is led as per intuition to want to know why. Let any one who has had experience with the mining game, not only as a locator but as a prospector, who can handle a single-jack, or a miner who takes a shot at a mining claim while supporting his family, or a small company holding good ground but hard to finance, and others who know something about it; let them, I say, read again and again and digest this new mining law, and they will discover it to be the most odious perfidious graft for the big interests ever presented to the American public, favoring especially the porphyry-copper magnate.

It is not my intention to dissect the various clauses of the so-called new mining law, for I am working hard and though nearing sixty years I have at this date this very year almost completed one hundred feet of underground work, besides having earned by the day some two hundred dollars working for a small company located not very distant from me, but others will take the matter up and not only dissect such would-be law but vivisect it as it deserves to be. However, let us take Section 5, Article A: "A full claim shall be forty acres square, conforming to the four cardinal points of the compass [very good] but the same can be sub-divided into ten acres square, subject to limitations contained in Article B, same Section. Mineral shall not hereafter be necessary in order to locate and hold a mining claim." But here our porphyry friends are showing their Italian hand. Said claim cannot be held over five years except by the money power. The same article provides further on that an extension of five years can be gotten by paying $50 an acre per year. At that rate an ordinary claim, such as we have today, would pay $1000 per year. Does the average man grasp the meaning of that? A noted engineer who took an option on my claims in 1912 told me in this very cabin where I am now writing that bearing porphyry contains from 5,000,000 to 7,500,000 tons of disseminated copper ore. Let us place the profit at one dollar per ton. We readily see that our porphyry friends and magnates are not shouldering much of a burden when paying $1000 per year for such a privilege, or for time to ascertain by drilling whether the ore is there or not. It let the cat out of the bag in Article C of Section 5 when it says: "If discovery of valuable mineral be made by drilling more than one hundred feet in depth, the claim can be made legal."

The reader can peruse Article E, same Section. Article F is a rigmarole about Alaska, carefully preceding Article G. Article G, same Section, reads: "A mining claim must be patented within seven years". There is no choice as we have today, all consideration is waived—it must be done. It does not take into consideration men of small means, of sickness, of locality, whether or not the work attained so far has exposed enough merit to justify a patent. No. The owner or owners must lose their work, their discovery, for no man would dream, even if he could spare the money, of paying $50 per acre for forty acres, or most any less money whatever, for a claim which still remains doubtful, for any mining claim carries an element of risk short only of a developed and exposed mine. And we are told that the above said law is evolved by a select few. Where would poor old Tom Cruse have found himself? He couldn't even get flour. All he had in the world was a stout heart, and Providence gave him time. Laughed at, scoffed at, he won out because he had the heart, the spirit, and nature gave him health. There are and have been a great many Tom Cruses, but the select few are too big to understand that.

In Article G the big interests have other innings, for they have twelve years to prove up on their original non-mineral location. A word here for the non-initiated. On a patent the Government gets five dollars per acre. The additional cost right here was three times that much before the War. What would it cost today? I do not know, for I have not inquired, but certainly it is not less. Section 10, cinched by Section 11, imposes excessive hardships to the pocket-book of the prospector and men of small means. The monument of old sub-divisions are

hard to find at times and not always correct, for some were placed a hundred feet out of line. To rectify same, it would cost time and money. We pretend to have so much solicitude for the disappearing prospector, and that law will certainly not bring him back. He is the one who finds the mine or reveals the index leading thereto. The engineer follows and may make the mine, but he never finds it. The engineer field-man is over-cautious, for it pays him to be so, and I for one don't blame him. We find him nice and well-versed but we know by precedent that he is not infallible. As to the geologist, he is certainly useful, but he is not master of the trade. More could be said about this said mining law or about the lot of the prospector; for my part this should suffice.

Jungo, Nevada, August 15. A. D. RAMEL.

N. B. We the undersigned prospectors endorse the above fully:

J. W. WILSON
A. E. PETTITT
N. T. HOLBROOK
B. G. ALY
EUGENE KRUEGER.

Non-American Issues

The Editor:

Sir—In your issue of June 18, when referring to Rear-Admiral Sims' utterances at London banquets and luncheons, in regard to the Irish question, you state, "It is inadvisable, if not worse, to permit our national solidarity to be disintegrated by a controversy over a non-American question". This bit of advice is similar to that of Washington's advising us against entangling foreign alliances. All of which is sound advice. But what are we to do when a people, citizens and non-citizens, insist on injecting non-American questions into our politics? We don't have to go to Europe to get entangled into European affairs, they can easily be brought over here. They are being brought over here. From what is transpiring it looks as if we might fight 'The War' over at every election, as, in the past, we have fought the Civil War over at every election. A condition might easily prevail here similar to what existed in the Balkans and in Denmark before the War. In the Balkans they had their German party and their Russian party, and in Denmark they had their English party and their German party.

A worse state of affairs can hardly be imagined. It is something to be guarded against. Advising against it helps a little; but it is not sufficient; something else must be done. Something must be done to prevent any non-American faction from controlling elections. The present methods do not do this; they, in fact, make such a thing possible. The whole thing is a question of voting.

The following is a description of a method of voting that, I think, will prevent any particular faction from controlling elections. It is the compromise method of voting. A method of voting whereby competent and impartial officials can be elected in one election, if officials are elected directly from candidates nominated by petition. The problem in electing impartial officials is how to prevent any party, religious sect, order, race, nation, or any body of men whatever from controlling their election, for if any of these control the election of an official, that official must be partial to them.

The method is as follows: Where one is to be elected, vote for the least majority of the candidates. The least majority is the first number larger than one-half the number of candidates running; for example, if three are running, vote for two; if four are running, vote for three; if five are running, vote for three. By causing the voters to vote for one more than one-half the candidates running, we force them to compromise on some one candidate. Being a compromise, an officer's election by this method of voting would not be due to any particular party's influence. He would, therefore, be able to act impartially.

It would work somewhat as follows: Of a number of candidates running for an office, a voter's first choice would be the candidate who would serve his interests the best, his second choice would be the candidate who would serve his interests next best, and so on. The first choice of another voter, whose interests are opposed to those of the first voter, would be the candidate who would serve his interests best, his second choice would be the candidate who would serve his interests next best, and so on. The candidate chosen last by one side would most likely be the last chosen by the other side, and would, therefore, receive the most votes. The last choice of a voter would be considered less friendly than his first choice, yet more friendly than the first choice of an opponent. There would be no first, second, or third choice marked on the ticket; these terms are simply used to show the working of the method.

The method will help to get competent men in office, because acts of ignorance have much the same effect as acts of partiality. Therefore, the incompetent will be eliminated as well as the partial. Much the same method is used in selecting a jury. The only difference is, in selecting a jury the undesirable jurymen are eliminated, and by this method the desirable are selected. The result is the same. Prize-fighters use practically the same method or principle in selecting their referee. The same principle is used in buying and selling in the open market.

This method of voting may be called the compromise system of voting. Or it may be called a concurring-majority voting system to distinguish it from disagreeing-majority voting systems, as all other systems may be called.

Nothing will stop so effectually the ill effects of any attempt to inject non-American questions into our politics as a method of voting, such as compromise voting, that will give us competent and impartial officials. The question of injecting non-American questions into our political affairs is far more serious than most people imagine. During the War it was reported that Von Kuhlman had told a French ambassador in London, some time before,

that he had worked out a scheme whereby Germany could control the politics of the United States. He said the Germans had not interested themselves in politics like other people, like the Irish for instance. If they had they could easily control the politics of America. There is no use arguing it can't be done because it has never been done in the past. The only reason it hasn't been done is because there has never been any well organized effort made to do it. With all the various propaganda bureaus in this country, we are in a fair way to witness the effect of such an effort.

The compromise system of voting is based on the principle of compromise rule, which is truly democratic, instead of being based on the principle of majority rule, which is, essentially, no more democratic than minority rule or kingly rule. The doctrine that majority rule is democratic is a lie and an illusion. It is the greatest obstacle to right political thinking in the world today. It is the greatest political superstition of all time. And not until we have thrown it into the scrap heap with the divine right of kings will we ever make much progress politically.

WM. CROCKER.

Prescott, Arizona, July 26.

AT a recent meeting of the Society of Chemical Industry, in London, Dr. L. Levy and D. W. West, in discussing the industrial respirator, said that it consists essentially of two parts: a face-piece and an absorption apparatus. The face-piece may consist only of a mouth-piece and nose-clip, but this form causes much discomfort and affords no protection to the eyes. The second and more recent form is a complete mask of rubber fabric with eye-pieces of glass so arranged that the incoming air passes over the inner surface of the glass, thus preventing dimming by moisture from the breath. This form requires neither the use of a mouth-piece nor of a nose-clip, and may be worn for a much longer period than the former type. The purifying canister is of the form used in the small military box-form respirators, and the substances employed for absorption should have a high capacity and rate of re-activity for the gases to be removed from the inspired air. The absorbents used vary according to the toxic substance to be dealt with; crystallized copper sulphate, highly activated charcoal, and a mixture of alkali and charcoal powder are used, respectively, for ammonia, hydrocarbon, and other neutral gases, and acid gases. A satisfactory means of removing smoke and solid particles is a mask of fine felt, fitted with an efficient non-return valve for the egress of the expired air. No absorbent for carbon monoxide is known that is suitable for use in a respirator, and, therefore, the catalytic oxidation of this gas by oxides is employed. But this method has certain disadvantages, for example. the harmful effect of moisture upon the catalyst (which may be overcome by a preliminary passage of the gases through calcium chloride), the absorption of a portion of the atmospheric oxygen to oxidize the carbon monoxide, and the absence of any indication of failure in the respirator. The last-named defect may be remedied by using an upper layer of iodine pentoxide and sulphuric acid which, when any carbon monoxide unoxidized by the catalyst is absorbed, liberates free iodine vapor that acts upon the throat of the wearer and thus indicates the breakdown of the purifying medium that is used.

ON the closing days of the last calendar year, December 30 and 31, 1920, the movement of gold between America and the Far East reversed its course, and the current for the first time in over two years began to flow toward the United States, writes Economist Consul F. E. Lee from Shanghai. In 1919 China as a whole imported gold bars and bullion to the value of $79,295,738, U. S. currency. Fully as much was imported in the first seven or eight months of 1920; but at the end of that period the unsettled market conditions in the United States and the rest of the world virtually wiped out China's export trade, and its capacity to absorb the yellow metal ceased. When at the close of the year and in the days preceding the Chinese New Year, February 8, silver exchange dropped to 2 to 1 and below, two dollars Mexican for one dollar gold, the Chinese dealers began to take their 100% profit on their gold purchases, and export began. From the port of Shanghai alone the exports to the United States between December 30, 1920, and February 21, 1921, amounted to approximately $10,000,000 gold. The principal cause for this export of gold is that it is an exchange transaction in which the Chinese dealers have made large profits. Much of this gold was purchased when $1 Mexican would buy $1.14 gold. A second cause for this export is that with the stoppage of exports and the impossibility of consignees accepting imports because of the unsettled conditions, less gold is required by the foreign-exchange banks in handling foreign-exchange transactions, so the surplus is being sent to points where it is more readily convertible. The revival of export trade will cause a greater demand for silver, and gold is being exported in order to purchase silver with which to make purchases of export stocks in China. The attractive opportunities in American securities at the present time may also have some bearing on this movement of the precious metals.

THE report for the year 1920 with regard to the administration of the territory of Papua states that it has been a successful one, and that the increase in exports and revenue was large, and the returns generally of an encouraging nature, says the weekly bulletin of the Department of Trade and Commerce of Canada. The revenue amounted to nearly £80,000 as compared with £61,000 for the preceding year. The value of imports was £422,741 as compared with £258,112, and exports amounted to £270,481, as against £176,247 for 1919. Osmiridium, which has been found in Papua for some years in small quantities, is recorded for the first time as an export, the amount exported being 88.5 oz. Gold exports also showed a slight increase. Only a small amount of silver is produced in the territory.

REVIEW OF MINING

HAYDEN BILL BECOMES LAW

President Harding has signed the bill introduced by Carl Hayden, Congressman from Arizona, providing for a change in the 'assessment' year with respect to unpatented mining claims. Claim owners will have until 12 o'clock noon, July 1, 1922, in which to complete assessment work for the year 1921. Thereafter the work for each year must be completed by noon of July 1 instead of by midnight of December 31, as formerly. Work for the year 1920 became delinquent at midnight of July 1, 1921, according to the provisions of the former law that made work performed on or before July 1 applicable as of the calendar year 1920. Work commenced before midnight of July 1, 1921, could be continued uninterrupedly until the required amount was performed; that is, no adverse claimant could re-locate the ground while the former claimant was engaged with his work even though the prescribed time had passed.

The New Mill of the Simon Silver-Lead Co. in the Simon District, North of Mina, Nevada

BULLETIN ON LAWS REGULATING PETROLEUM PRODUCTION IN AMERICA

The publication of Bulletin 206, 'Petroleum Laws of all America', by J. W. Thompson, law examiner, is announced by the United States Bureau of Mines. The bulletin includes the petroleum laws of the United States, the several oil-producing States, Canada, Mexico, and the Republics of Central and South America. The report has been prepared in response to the wide demand for information regarding the laws regulating leases and concessions, and the explorations for and exploiting of petroleum in these Republics. The petroleum laws of the Spanish-American Republics are usually supplemented by decrees of the Presidents, which serve the purpose of regulations. Such decrees may not change or annul absolutely a congressional enactment, but they may in effect modify the application and enforcement of the laws. These decrees may be issued at any time, and it is highly important for concessionaires to keep advised as to the latest decree. The same statement applies to the orders in council issued by the Canadian government. The commissions of many of our own States have wide authority in regulating the operations of State laws, and their regulations are subject to change and amendment. Compliance with any such decrees, orders in council, and rules of the State commissions is as essential as obedience to the laws themselves. Copies of the bulletin may be obtained from the Superintendent of Documents, Washington, D. C., at a price of 40 cents.

SIMON SILVER-LEAD CO. IS COMPLETING ITS MILL

The new 150-ton flotation plant of the Simon Silver-Lead Co., in the Simon district north of Mina, Nevada, is practically complete except for the erection of the flotation machines. The machinery has been shipped from San Francisco and the timber is already framed at the plant so that but one week's work will be required to install the flotation equipment. The ore, as supplied to the mill, will average 5 oz. silver, 8% lead, and 9% zinc; the treatment will be preferential flotation, the lead being removed by the first machine, while the zinc is dropped. The tailing from the lead machine is then to be passed through a second for the flotation of the zinc. Lead concentrate will be shipped to the U. S. smelter at Midvale, Utah, whereas the zinc product will go to a smelting plant at Harbor City, California, that was recently purchased by the Simon interests. The details of the metallurgy there are not fully determined, but lead-silver bullion and lead-free zinc oxide will be the products.

The situation of the plant at tidewater will be an advantage in marketing the oxide.

The power-line being built by Mineral county from Hawthorne to the Simon district is expected to be completed by October 15. The post-holes have been finished and the poles and wires will be on hand soon. The work is under the direction of Joe Beane. Everything at the mine and mill will be in readiness for immediate operation as soon as the electric current is available.

Development work in the mine has been discontinued for the time being and the task of putting the chutes, tracks, bins, and skips in shape for steady production is in hand. A new ore-pocket is being built below the collar of the shaft to provide storage capacity at this point. The ore will be withdrawn in a short adit and will be hauled through it and around the contour of the hill to the mill crushing plant which is about 300 yards away. The ore-reserve totals 500,000 tons of assured ore of the approximte grade mentioned above.

Mr. P. A. Simon, president and general manager for the company, is well satisfied with the mill, and while he doesn't, as he says, "expect to press the button and have everything start without a hitch", he is confident that regular shipments of concentrate will start well before the first of the coming year.

FINANCES OF UTAH COPPER COMPANY

The interesting feature of the report of the Utah Copper Co. for the second quarter of this year was the item of $547,584 for 'shut-down expenses' of its mine and plant. While at first glance this seems to mean that the big copper company is spending at the rate of $2,300,000 per year to stay closed down, such is not strictly the case, says the 'Boston News Bureau'.

In the quarter just reported, Utah had to clean up raw copper in process and finish up other work in hand; the last few pounds of mine production on hand at the date of the shut-down, April 1, was put through the reduction works. This resulted in an output of 1,406,000 lb. of copper, but the expense of keeping the plant in operation to treat this amount was almost as heavy as though the usual monthly production was put through. It is doubtful, however, if monthly expenditures hereafter will exceed $100,000. Utah Copper in the second quarter again dipped into surplus to continue dividends, the tenth consecutive quarter it has done so. Including the deficit of $1,254,474 after dividends shown in the second quarter, Utah thus far this year has disbursed nearly $3,000,000 from its treasury. In 1920 its deficit after dividends amounted to $4,317,207 and in the year before that, $1,494,544. In the last two and a half years, therefore, Utah has paid out in unearned dividends over $8,782,000.

Its ability to do this is a direct reflection of the conservative action of the management during the prosperous war days. In the four years ending in 1918, Utah Copper earned $65.61 per share on its 1,624,490 shares of stock, after all reserves for depreciation, depletion, and extraordinary taxes. Of this it distributed $40.75 per share in dividends, leaving nearly $25 per share turned back into the treasury, as per the following:

	Net earnings per share	Surplus after dividends
1918	$11.66	$2,700,880
1917	18.46	6,430,002
1916	24.46	19,655,064
1915	11.03	10,462,665
Total	$65.61	$39,248,611

This resulted in increasing the earned surplus from $13,552,000 at the end of 1914 to nearly $51,000,000 at the end of 1918.

W. P. HAMMON OPTIMISTIC REGARDING GOLD MINING

W. P. Hammon, who is prominently identified with the gold-dredging industry, recently returned to San Francisco from a four months business visit in the East and in the Mountain States. He is optimistic regarding business in general; apropos of gold mining, he is quoted as saying:

"There is no question that capital has resumed its interest in the gold-mining industry. It is reviving in Colorado and throughout the entire mountain region. I was able during my trip to finance a $1,000,000 transaction, and that is a good indication, because six months ago it would have been impossible to interest capital in such an undertaking. In the mining towns, the workmen are clamoring for something to do, and the State officials are ready to help all they can. I was considering a big hauling contract in Idaho, to move machinery to a mine. Of his own accord, the supervisor of roads in that district called on me at the hotel, and next day put a large force of men repairing the road, so as to save us money on our haul. In fact, I am enthusiastic over the excellent spirit displayed by everybody in reviving the gold-mining industry."

FRESNILLO STARTS PRODUCTION

According to the 'Financial Times' (London), the Mexican Corporation announces that the first unit of the Fresnillo mill consisting of one-half of the plant has commenced operations. It is anticipated that the remainder of the plant will be brought into operation in September. The Fresnillo silver mine, in which the Mexican Corporation will have a large interest, is situated in the State of Zacatecas. The Fresnillo consists of two ventures—one of the immense quantity of ore comprised in the Cerro de Proano, and the other the old mine worked many years ago below the surface deposit just referred to. The Cerro de Proano is a small hill about 300 ft. high which rises out of the surrounding plain. It has a circumference of about two miles, and consists almost entirely of a mass of silver-bearing veins running in all directions. After an exhaustive examination, the profitable portions of this mass of ore were estimated to contain a minimum of 4,000,000 tons, with an average value of about 5¼ oz. silver. Since the taking over of the property more extensive development and exploration work has been carried out, with the result that it is now estimated that a further 2,000,000 tons of ore can be regarded as ultimately available. Very little labor is required in working this body of ore. Adjoining this hill is the old mine, which has a long history, and which, from reliable records, had produced, up to 1903, over 150,000,000 oz. of silver.

FUTURE OF GOLD INDUSTRY

F. H. Hamilton, speaking as chairman at a recent meetnig of the H. E. Proprietary company, in London, said:

"I should be the last person to venture any dogmatic opinion upon a question the factors of which are so complex and confused. I may, perhaps, be permitted to state, however, that I believe the time when the gold industry will come into its own again is not at all remote. A distinct change of sentiment is already apparent. It is, I think, today generally recognized that a policy of artificial deflation which does not correspond with or represent an increase of commodities is just as disastrous as the contrary policy of sudden inflation by the wholesale manufacture of credit. Each of these policies has been tried; the gold-mining industry has suffered from both. When the pound declined in value the cost of all material was higher, and labor on the Rand seized the opportunity to raise wages. When, again, our own Treasury attempted to deflate currency and to raise the relative value of the pound the premium on gold declined, but wages remained at the old

level. The consequence is that the gold industry was bled at both ends. It retaliated in the only way open to it by falling into a decline, not because it was sulky, but because, whatever advanced politicians may say to the contrary, an industry cannot pay more out than it has in it.

"One result is that the production of gold all over the world fell from about £93,000,000 in 1914 to £73,000,000 in 1919, a reduction of over 20%. Another is that many of the low-grade mines on the Rand have been living from hand to mouth, and white labor has been faced with this dilemma: that unless a reduction corresponding to some extent to the decreased prices of commodities is made many mines will be forced to close down and a large amount of unemployment will ensue, which will ultimately force down wages. It would almost seem today that the tide has turned. There are signs of a disposition on the part of white labor to meet the situation by reasonable concessions, and a certain measure of relief in this direction may be hoped for which, of course, would be reflected in working costs. The price of mining material has already declined.

"Then there is the question of the gold premium, and here, too, the industry seems likely to benefit. The idea seems at one time to have gained currency that this gold as measured by the pound sterling is a temporary phenomenon and that before long it will disappear; and that it will be possible for the country to return permanently to an effective gold standard. It would be out of place at this meeting to discuss the strong and, I think, convincing reasons that exist to the contrary. I will merely content myself by stating my own confident belief that for the next ten years, and probably for a much longer period, the pound sterling will be at a discount relatively to gold; that any attempt within that period which this country may make artificially to deflate to the gold level must fail, and, finally, that if it could succeed the political consequences would be of a disastrous character. If this view is correct it follows that gold mining has already passed its worst period, and that we are likely within the near future to see a much larger margin of profit on the medium-grade mines."

PORTLAND CANAL MINING CONGRESS

The Portland Canal Mining Congress has recently been organized as the first step in a concerted effort to bring more generally to the attention of the mining public the mineral resources of the region centring at Hyder. The remarkably rich Premier mine, lying almost on the boundary between Alaska and British Columbia, is the mainstay of the district at the present time, but shipments have been made from a number of other properties and the future prospects are bright. Plans have been made for sending an exhibit to the exposition to be held at Chicago in October under the auspices of the American Mining Congress. The accompanying illustration shows the group of mining and business men who organized the Portland Canal Congress. John T. Reed was selected as permanent chairman and Bernard M. Stone as secretary.

Members of the Portland Canal Mining Congress

From left to right, rear: F. C. Lawrence, Dan Lindeberg, Angus Kennedy, J. A. Hall, William Forrest, Bernard M. Stone, Dr. W. D'Arcy Chace, R. J. McDonnell, Oren F. Hill, D. W. McLeman, S. G. Benson, John T. Reed, U. S. Commissioner, M. R. Jamieson, W. J. Crawford, E. R. Stivers, Customs Officer, James Nesbitt, William Bunting, P. C. Beaudreau, Charles Traversy, Captain John Irving, S. P. Fitzgerald, John Hovland. Front row: Dale L. Pitt, W. R. Tonkin, Dan Davis, Hugh MacDougall, M. Meisingseth, N. Beyin, W. R. Hull, James Daly.

DELAY IN ALLOWING REDUCED FREIGHT-RATES TO BECOME OPERATIVE

The Interstate Commerce Commission has temporarily suspended the proposed schedules that would reduce sundry rates, including many applying to shipments of ore and bullion. The delay in most cases is for three months and for the purpose of allowing additional investigations to be made by the Commission. With the railroads ready to make the reductions in many instances, it hardly appears logical that the Commission should not allow the rate-

reducing schedules to take effect immediately. Explanation is offered that two factors govern the Commission in its allowance of rate reductions. It must balance cuts in rates so that one road will not gain an undue advantage over another and it must also watch the interests of industries in order to prevent any unfairness of competition to enter through inequality of rates. Another reason that makes it necessary for the Commission to consider these reductions with care is that it must be determined that the returns will not fall below the guarantee given the roads.

WAR MINERALS RELIEF TEST CASE PENDING

It is reported that Charles Dawes, Director of the Budget, will seek to have returned to the Treasury the unexpended balance of the 'war minerals relief' appropriation amounting to over $5,000,000, but that this action will be opposed by the Interior Department, on the ground that the money should remain available until all claims are settled. Many of these are held up pending action by the House on the bill already passed by the Senate providing for more liberal interpretation of the Act. The necessity for this legislation is apparent from the decision of the Comptroller General declining to re-open the case of Samuel H. Dolbear for an additional allowance of $2840. This was considered a test case, as, had the Department been able to re-open it, it could make additional awards in other cases. The Comptroller holds that government accounting officers are not authorized to re-open, on questions of law merely, accounts which have been settled by their predecessors. He also was disinclined to exercise any jurisdiction in this matter while measures for the claimant's relief are pending before Congress.

RICH ORE SHIPPED FROM KENO HILL IN THE YUKON

Silver and lead ore valued at $600,000 from Keno Hill, the new district on the Stewart river, near Mayo, Yukon territory, reached Seattle recently. It was forwarded to the Selby smelter, near San Francisco. There are 3000 tons of ore in the consignment, valued at about $200 per ton. The ore was sacked at the mine before shipment by the Yukon route to St. Michael.

ARIZONA

Bisbee.—The Copper Queen branch of the Phelps Dodge Corporation has had a force of electricians at work recently installing a Gamewell fire-alarm system through the various buildings that belong to the company. There has been ordered a La France fire-truck similar to that owned by the city. The central station of the company will be at the Lowell shaft, where the truck will be housed. Three shifts of men will be on hand to respond in case an alarm is turned in. The Copper Queen hotel, the Y. M. C. A. and Y. W. C. A., the Western Union building, the dispensary, the store and warehouse, and other buildings belonging to the company are being connected with the system. In each building there will be a number of boxes from which the alarms can be turned in. In a number of the buildings there will be master boxes which will show where the fire is located when an alarm is turned in. The system will also be connected with the central fire-station of the city at the city hall and also at the Lowell fire-station, so that the alarm will register there.

The second quarterly report of the Shattuck-Arizona Copper Co. states that 3265 ft. of development work was performed. Regarding the new discovery on the 600-ft. level the report has this to say:

"A new and important discovery of copper ore was made and is now being developed on the 600-ft. level near the boundary of the Roy and Leo mining claims in the north-east end of the property. The ground under development is practically new territory, and as there is a rich copper showing surrounded by a large body of copper-bearing gossan, we are assured of a good tonnage of commercial copper ore in this section of the mine. Ore indicated during the first quarter of the year in No. 86 cross-cut was found in No. 89 cross-cut, and to date we have opened up an ore-shoot for a length of 85 ft. The average content of No. 89 cross-cut is more than 20% copper and 20 oz. of silver per ton. The new ore is a mixture of copper carbonates and copper sulphide (glance) in an iron gangue. The glance ores assay slightly more than one ounce in silver for each per cent of copper content."

Hayden.—No shipments of direct smelting ore were made by the Ray Consolidated Copper Co. during the second quarter of 1921, and the production from concentrating ore was 1,546,535 lb., as compared with 8,802,186 lb. during the preceding quarter. The operating loss was $85,619, and plant shut-down expense was $289,994, making a total of $375,613. Miscellaneous income was $5404, leaving a net loss for the quarter of $370,209.

Kingman.—Reports from the Katherine mine state that 30 men will be added to the force working on development. In addition to opening the orebodies already discovered, a force will start sinking the winze to the 700-ft. level. The tonnage of blocked ore is said to be sufficient to warrant the erection of a mill.

CALIFORNIA

Angels Camp.—W. O. Crosby and W. J. England, who recently acquired the Washington mine, are adding new machinery and remodeling the 5-stamp mill. The deepest workings do not extend below 180 ft.; $400,000 is said to have been produced from above this point. The new name will be the Bullion Hill Mining Co.

Death Valley.—The Pacific Coast Borax Co. is shipping 20 carloads of borax monthly and the accumulation is being cleared rapidly. Mining will probably be resumed about October 1.

French Gulch.—Work has been resumed at the Gladstone mine after a shut-down of six years. The mine was discovered in 1890, since which time it has produced more than $3,000,000 in gold.

Quincy.—Rich gold-silver ore has been uncovered in the Plumas-Eureka Annex near Johnsville, according to Dean Durham, president. An adit is being driven to develop the veins.

Randsburg.—The California Rand Silver, Inc., is hastening work on its new assay office. The old office was destroyed by fire on August 19, and the new plant will necessarily be equipped with entirely new apparatus.——A shaft on the Grady's Venture claim has reached the 25-ft. point. A carload of lumber and machinery has been received, and a plant sufficient to sink to 500 ft. will be erected at once.——Thirty stamps are dropping at the Yellow Aster mill. The ore is coming from lessees in the upper levels.

Shawmut.—It is announced that the Belmont Shawmut Mining Co., a subsidiary of the Tonopah Belmont Development Co., will resume output early in September. Production was discontinued in August 1920, when the cost of labor and supplies became prohibitive. The mine is comprehensively developed and is equipped with a 500-ton reduction plant. Recent work has been directed to improving the conditions underground for economical operation.

Sutter Creek.—Preparations are being made for sinking the Central Eureka shaft to the depth of 4100 ft. The shaft is inclined at about 60°.——Superintendents of mines on the Mother Lode held their regular monthly meeting at the Fremont mine on August 27. Edwin Higgins, manager, and B. I. Hoxsie, superintendent, of the Fremont mine, were hosts.

COLORADO

Aspen.—The Silver Mines Company of America, organized and financed in Philadelphia, is treating ores mined in the Cowenhoven tunnel at the Hunter mill; it is also handling custom ores. It is estimated by the company's engineers that there is low-grade ore available to keep the mill in operation for many years and custom treatment will be abandoned when this ore is blocked-out for milling.——The Park Tunnel Co. has under consideration the construction of a tramway and one-half of the necessary $22,000 has been subscribed by stockholders at Leadville and this city. The tram would take care of ore from both the Park and Jenny Lind tunnels.

Cripple Creek.—Sinking has been resumed at the No. 2 or main shaft of the Portland Gold Mining Co. on Battle mountain. For safety, a winze was sunk outside the station at the 2450-ft. or bottom level, and at a depth of 15 ft. a cross-cut was carried directly under the shaft, providing 15 ft. of solid rock as a bulkhead. The company's engineer had recommended this plan, as a bulkhead could not have been constructed of sufficient strength to withstand the weight of cable and skips in case of accident. The shaft is reported to be comparatively dry, as veins carrying water have dipped out of the shaft. The depth of the present lift will be 200 ft. and the station will be cut at an elevation of 7594 ft., a total depth from the surface at this point of 2650 feet.

Rich discoveries have recently been made at the American Eagles, at the El Paso Gold King, originally located by Robert Womack as the Chance, and at the Lexington on Gold Hill. The last two are surface discoveries.

Leadville.—Four shafts are in operation on the Little Johnnie, where about 150 miners are employed by lessees. A good grade of ore is going out from shafts No. 2 and 4. ——The Third Venture Mining Co. is extending the St. Louis tunnel to prospect the Colorado Prince and other holdings on Breece mountain. The Colorado Prince is reputed to be the first mine to find gold in the Leadville district.

Lessees on the Fanny Rawlins are mining and shipping ore broken between the second and fourth levels and shipping steadily to the Arkansas Valley smelter.——The Fidelity G. M. Co., operating in Black Cloud gulch west of Twin Lakes, is mining and shipping smelting ore only, and saving mill-ore in anticipation of constructing a mill. Returns on smelting ore range from $87 to $350 per ton.——Work in the Canterbury Hill tunnel project continues.

IDAHO

Coeur d'Alene.—A 10-cent dividend was declared by the Hecla Mining Co., at the meeting in which the company ratified the action of the directors in settling with the Marsh Mines Co. and the Federal Mining Co. The dividend of 10c. per share amounts to $100,000, and is the third dividend this year, making a total to date this year of $330,000, and a grand total of $8,835,000.

Fifty tons of ore has been shipped by the lessees in the No. 4 tunnel of the Western Union Mining Co. This is the nineteenth car shipped by them this year and is said to contain about the best ore they have ever taken out. It was sent to the Bunker Hill smelter at Kellogg.

Fairfield.—The Walton Mines Co., operating 15 miles north of here, expects to finish its mill and commence the shipment of concentrate to Salt Lake City about September 20. Three hundred tons of mill ore, assaying $20 to $30, already has been stoped for milling.

MICHIGAN

Calumet.—As a result of further curtailment, 300 additional men have been laid off by Calumet & Hecla. Costs not absolutely essential to the maintenance of the property have been eliminated in every department. The power-plant at Lake Linden will continue to operate to supply the electric pumps at the mine, while steam will be maintained at the mine to operate the steam pumps and bailers. Sixty-five men have been retained for work on the pumps.

The property of the Superior Copper Co., a subsidiary of Calumet & Hecla, closed since December 1, 1920, has been permanently abandoned. The ground has been thoroughly explored by means of diamond-drill holes, cross-cuts, and drifts, but has been found to be badly faulted. Figuring only mining costs and mine taxes it cost Superior 37.60c. per pound for the 322,871 lb. of copper produced in 1920. The company finished 1920 with a balance of current assets of $400,650, equivalent to a little better than $4 per share.

The surface plant of the White Pine Extension Co., owned by the Resource Development Co. of Detroit, is being dismantled preparatory to shipping it to Michigamme in Marquette county, to be set up as a temparory plant at the Imperial iron mine, owned by Henry Ford and recently reopened after a long period of idleness. The Imperial mine is part of the property of the Michigan Iron, Land & Lumber Co., a Ford subsidiary. The removal of the surface plant probably seals the destiny of the White Pine Extension. The mine was under development by the Stanton interests, in association with a number of Detroit men. The results have been only of mediocre character. The problem at White Pine Extension is one involving extensive development and the use of the flotation system for the extraction of the copper.

Calumet & Hecla has added to its already large supply of Danish flint pebbles for its grinding mills at Lake Linden. A cargo of 2200 tons recently was received from Copenhagen. The pebbles are harder than any which can be obtained in this country, and for the grinding of conglomerate 'rock' are more satisfactory than steel. Steel pebbles are used to advantage on amygdaloid 'rock' only.

NEVADA

Divide.—The Tonopah Divide and Divide Extension companies are shipping regularly to mills in Tonopah. The Gold Zone is working at 900 ft. Several of the smaller companies are expected to resume, including the Alto, Junior, and Giant. The Tonopah Divide soon will resume sinking the shaft from the present depth of 1000 feet.

Gerlach.—The Leadville Mines Co. is shipping monthly four carloads of concentrate worth $150 per ton, or a gross monthly production valued at $30,000 from the treatment of 30 to 35 tons of ore daily.

Goldfield.—Umpire assays on the 60-ton shipment made nearly a month ago from the Donald and Giles lease on the Florence give the ore a value of $148.40 per ton. Ore of a gross value of more than $10,000 has now been shipped by the lessees as a result of their work in the hanging wall of the old Reilly flat stope. Three raises are being driven to prospect the orebody. The lease has been renewed for two years.——Barker, Heiden, and Witt, in the vicinity of the Engineers' stope, are hoisting a carload of $100 ore, according to their estimate. These lessees have not been in ore for many months and the shipment will consist of ore mined nearly a year ago.

Pioneer.—The Mayflower has levied assessment No. 7, at the rate of 1c. per share, delinquent October 10, 1921. The $10,000 indebtedness of the company has been reduced by $2700 during the period from January 1 to August 31, 1920. The report says of the Starlight workings, the most promising in the mine: "The ore exposed at this point outcrops on the surface and assays from $3 to $29.60 per ton, the average value being about $12 per ton, the vein having a width of more than 5 feet.

Ruth.—The Nevada Consolidated Copper Co. is develop-

ing the high-grade direct-smelting ore opened some months ago on the 700-ft. level of the Ruth mine, with favorable results. The operating loss during the period was $22,605, plant shut-down expense was $247,090, and miscellaneous income showed a deficit of $9163, making a total loss of $278,858. The company has disposed of all metal produced during the first quarter of the year, besides an appreciable amount of the surplus that had accumulated to January 1. The smelter was shut-down late in May.

Tonopah.—The Belmont is setting new records. What is said to have been the most valuable bullion shipment in the history of the company was made a few days ago. This consisted of 60 bars containing $100,000 worth of silver and $25,000 worth of gold, saved during the first 15 days of August. A new hoisting record of 201 skips in six hours and 40 minutes also has been made, replacing the old record of 187 skips.——The second shipment this month of the MacNamara mill consisted of 12 bars weighing 20,407 oz. and valued at $26,000.——High-grade ore from the Divide Extension is being treated in the MacNamara. The Tonopah Extension has sued the Cash Boy for $15,394 for ore alleged to have been mined by the latter from the Golden Anchor claim of the former. This ore is said to have been taken from between the 1435 and 1470-ft. levels in the period September 1917-July 1921.

UTAH

Alta.—A. H. Cowie has filed application with the State Engineer for the appropriation of 20 second feet of water from Little Cottonwood creek. It is proposed to divert the water at a point 110 ft. below the portal of the Wasatch Mines Co.'s adit; it will be carried through a diverting channel 13,700 ft. long to the point where it is proposed to build a power-house, with a capacity of 1500 hp. to serve mines in this district.

Beryl.—For seven years some development has been in progress at the Copper Zone mine, 12 miles from this station, in Iron county. Recently discoveries of an important nature have been made on the 200-ft. level, and as a result, the management is planning to equip the property with electrically-driven machinery. J. R. Rickards, superintendent, reports that the mineralization is similar to that of the famous Horn Silver mine at Frisco, Utah. Specimens have been found that assay as high as 5000 oz. in silver. The recent discovery, however, shows cerargyrite, native silver, and gray copper. The company has expended during the past seven years about $84,000 in developing the property.

Eureka.—During the week ending August 20, the Tintic Standard shipped 40 cars of ore; Chief Consolidated, 36; Dragon, 12; Victoria, 12; Eagle & Blue Bell, 11; Iron King, 9; Swansea, 7; Iron Blossom, 7; Colorado, 5; Centennial-Eureka, 5; Mammoth, 4; Bullion-Beck, 3; Gold Chain, 1; Bowers, 1; Tintic Mill (copper bullion), 1; making a total of 154 cars, as against 178 for the preceding week.

Gold Hill.—The Western Utah Copper Co., on its 700-ft. level, has entered a body of silver-copper ore that assays from 6 to 30 oz. in silver and from 4 to 15% copper. The ore has been drifted on for 40 ft., and a raise has been put up for an equal distance. Samples show most of the copper to be in the form of chalcocite and chalcopyrite, in a soluble lime gangue. The main ore-shoot heretofore developed at the Western Utah Copper is 300 ft. long and from 10 to 80 ft. wide. This shoot produced an excellent silver-lead arsenical fluxing ore, and at times as high as 300 tons per day was shipped to the Murray smelter of the A. S. & R. Co.

Grantsville.—Good silver-lead ore has been found at the property of the 'L' Marie Mining Co. by lessees, according to John V. Long, Jr., president. The property of this company is in the Stansbury mountains, about 9 miles from here. The new strike is but 30 ft. from the portal of the adit and 18 ft. below the surface.

Milford.—A large body of silicious ore has been developed in the property of the Leonora Mining & Milling Co., according to John Matson, president. As soon as the company can negotiate a favorable smelting contract, shipments will be started. Two carloads on the dump show returns of 20 to 35 oz. silver. A new shaft is being sunk, and is now at a depth of 145 ft. It is reported that E. J. Raddatz, president of the Tintic Standard Mining Co., and associates, have recently acquired a block of stock in the Leonora company.

Park City.—Ore shipments from this district for the week ending August 20 totaled 1212 tons, of which the Judge allied companies shipped 460; Ontario, 395; and Silver King Coalition, 357. Shipments the previous week totaled 1485 tons.

Salt Lake City.—Plans are being made for a convention of metal-mine managers and superintendents of Utah to be held in this city during the first week of October. At this convention practical problems of the industry will be considered, with papers and discussions on appropriate subjects. Arrangements for the meetings are in charge of the following mine superintendents: A. S. Winther, Utah Consolidated mine, Bingham, chairman; William Owens, Eagle & Blue Bell mine, Eureka, vice-chairman; N. A. Dunyon, Ontario silver mine, Park City; O. R. Friendly, Judge properties, Park City; J. D. Shilling, Utah Copper mine, Bingham; and A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress.

The largest exposition of the resources and opportunities of the metal-mining industry of Utah ever exhibited will be shown at the State Fair during October, according to plans being made by the directors of the Fair Association and the Utah Chapter of the American Mining Congress. A committee composed of Forrest Mathez, of the Silver King Coalition Mines Co.; E. A. Hamilton, of the United States Smelting Co.; T. P. Billings, of the Bingham Mines Co.; E. F. Birch, of the Knight Interests; and A. J. May, of the Tintic Standard Mining Co. will be in charge of the exhibit.

The Utah Salduro Co., which is the largest producer of potash in the United States, has been taken over by the Allied Chemical & Dye Co. of New York. The holdings of the Utah company are in the western part of the State, on the Great Salt Lake desert. The company has expended about $2,000,000 in a plant, which has a daily output of more than 100 cars of potash. Last year an average of 200 men was employed.

MANITOBA

The Pas.—Referring to the recent acquisition of the Flin-Flon copper property, the president of the Mining Corporation of Canada is quoted as saying: "Many difficulties and problems will be encountered in the development of this orebody, but the reserves already proved are so stupendous and, there being no metallurgical difficulties, we are encouraged to hope that we have reached our goal in providing for an indefinite life for the Mining Corporation of Canada."

MEXICO

Chihuahua.—Manuel Radrigues, of Urachic, has located some new claims embracing veins carrying gold, silver, and lead near the old Providencia mine in the Rayon district. The property is to be patented under the name of Mireya. ——The Ampliacion Amalia No. 5, situated on the Talamantes hacienda, in the municipality of Jiminez, has been filed upon by Abraham Fernandez, who recently discovered a large body of manganese ore containing silver. He has surveyed a group of 14 claims.——Jose Partida, of the city of Chihuahua, has taken over the Santa Eduwigs mine near Villa Coronado in company with Juan D. Lozoya.

Durango.—A general meeting of the stockholders of the Soto Mines Co., is to be held in New York City on September

20 at the offices of Charles F. Ayer. Plans for the future operations at the mines will be discussed.

Jose A. Estado has applied recently for titles to El Indio, a group of three silver claims in the municipality of Santiago Papasquiaro.——Andrews & Harrison, representing San Antonio, Texas, capitalists, who are operating the San Mateo mines in the Velardena district, have started using new power-drills. They were formerly producing about 50 tons of shipping ore per week; with the new equipment they expect to double this amount and will increase their shipments to the Chihuahua smelter accordingly.—The Ampliacion del Pichaco mine is being developed by Cruz Herrera. This property is located in the Topia district near several producing mines.

E. Kreklau, operating the U. S. mine in the Velardena district, has entered a body of rich silver ore at a depth of 100 ft. in the main shaft. Shipments are now being made.

Mocorito.—The El Palmerito silver mines have been taken over by Philadelphia interests. Miles Milward, who has been manager for ten years, has been transferred to Idaho by the new owners, and John Cadogan, superintendent under Milward for eight years, is now manager. The company owning the El Palmerito mines, the largest on the west coast, is building a 250-ton mill to replace the old 150-ton plant. The mines have been worked for 20 years.

Zacatecas.—Regulo Fuentes, representing Mario M. Blazquez, has taken up 20 silver-lead claims in the vicinity of Mazapil. The group is to be titled under the name of Ampliacion de San Francisco del Alto.——Flavio Hernandez has taken up some new copper prospects in the Mazapil; he has made application for titles to several claims known as La Abundancia group.——Manuel V. Armida has located six pertenencias embracing a strong vein of rich silver-lead ore in the Chalchihuites district.

ONTARIO

Beaver House Lake.—Work is being centred at the 350-ft. level and a large amount of ore is being blocked out. A large known vein has been entered at that depth.

Kirkland Lake.—Harry Oakes, president of the Lake Shore company, states officially that the physical condition of the mine is better than ever before and that the capacity of the mill has been increased until it is now able to handle close to 70 tons of ore daily.

Porcupine.—A considerable cut in the wages of gold miners is stated to be under consideration by the mine managers. Wages have been reduced in the pulp and paper trades and the silver-mining camps, but remain high at the gold mines, skilled men receiving $5.25 per day, as compared with $2.50 before the War. Common laborers get 56c. per hour, the rate paid at the silver mines being 45c. The effect of high labor cost is to prevent the milling of large quantities of 'ore' carrying from $3 to $5 per ton in gold, which cannot be economically treated under present conditions. With moderate labor costs this low-grade can be mixed with the high-grade and in this way utilized, thereby enlarging the output and employing more men. The general expectation is that a cut will be made in October.

The Dome Mines has sent out information to American stockholders pointing out that the Canadian government taxes only 50% of the amount of dividends paid by gold and silver mines, allowing the remaining 50% to be considered as capital return. Stockholders resident in the United States are advised to draw this matter to the attention of the authorities with a view to obtaining a similar ruling.

At the Beaumont lateral work is being carried on at the 150-ft. and 300-ft. levels to cross-cut orebodies indicated by diamond-drilling.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. H. Curle is in the Congo.

F. W. Bradley is at Juneau.

Arthur W. Jenks is in New York.

P. B. McDonald writes from Leipzig, Germany.

T. J. Jones is on his way from London to Moscow.

William McNeill has returned from Mexico to London.

Waldemar Lindgren has returned to Boston from Bolivia.

Arthur Moline, of Bendigo, Victoria, was in the Rand recently.

W. W. Mein is at Lake Tahoe; he was in San Francisco this week.

Walter E. Gaby, of Pachuca, Mexico, has been at Teziutlan, in Puebla.

John D. Hoffmann left San Francisco last week on his way to Siberia.

G. C. Jones, manager of the El Tajo mine, in Sinaloa, is here on a holiday.

John Crawford, State Inspector of Coal Mines for Utah, is in southern California.

G. Cleveland Taylor, of Redding, has been doing professional work at Randsburg, California.

L. Maurice Cockerel was at Los Angeles this week, on his way from London to Zacatecas, Mexico.

Arthur L. Walker, Professor of Metallurgy in Columbia University, has been on a tour in Europe.

E. P. Mathewson sails from New York for Burma, by way of London and Marseilles, on September 22.

Spencer C. Browne Jr. was married to Miss Lina Ferguson at Albuquerque, New Mexico, on August 10.

George Otis Smith, Director of the U. S. Geological Survey, has returned to Washington from London.

H. S. Munroe, general manager for the Granby Consolidated, has returned from New York to Vancouver.

R. E. Griggs, formerly at Johannesburg and now a resident of New York, was in San Francisco last week.

T. Skewes Saunders has resigned as manager of the Dos Estrellas and has opened an office as consulting engineer in Mexico City.

John A. Agnew and **A. Chester Beatty** are included in the committee of seven selected to advise the board of directors of the Burma Corporation.

M. V. Harper Carter, formerly of Platteville, Wisconsin, has been appointed Chief Engineer to the Harbor Department of Oakland, California.

Frederick Lyon, former vice-president of the U. S. Smelting Co., spent several days in Utah recently. He is on his way to California for an extended stay.

H. L. Smyth, Professor of Mining at Harvard, has been spending the summer in Michigan, as consulting engineer to the Cleveland-Cliffs Iron Co., of Ishpeming.

John D. Ryan, chairman of the Board of the Anaconda Copper Mining Co., who has been spending the summer at Swan Lake, Montana, has returned to New York.

I. N. Goff, of Pittsburgh, Pennsylvania, general manager for the Keystone Metals Mining Co., is making an examination of the company's holdings near Castleton, Utah.

Jesse J. MacDonald, representing James Irving & Co., of Los Angeles, has returned from the Bradshaw mountains, Arizona, where he made an examination of the Crown King, Wild Flower, and Tiger mines.

Paul Armitage, a director of the United Verde Extension Mining Co., visited the company's property in Arizona recently. He is now in the Yellowstone Park, and will return to New York early in September.

THE METAL MARKET

METAL PRICES

San Francisco, August 30

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25—12.50
Lead, pig, cents per pound	4.65— 5.65
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

August 29.—Copper is inactive and lower. Lead is quiet but firm. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 23	61.62	38.00	July 18	60.25	37.56
" 24	62.12	38.00	" 25	60.14	37.85
" 25	62.50	38.37	Aug. 1	61.66	39.05
" 26	62.00	38.00	" 8	61.46	38.62
" 27	62.00	38.00	" 15	60.81	37.02
" 28 Sunday			" 22	61.78	38.29
" 29	62.37	38.25	" 29	62.10	38.10

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	....
Mch.	101.12	125.70	56.08	Sept.	113.92	93.68	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Aug. 23	11.75	July 18	12.62
" 24	11.62	" 25	12.43
" 25	11.62	Aug. 1	12.04
" 26	11.50	" 8	11.75
" 27	11.50	" 15	11.75
" 28 Sunday		" 22	11.75
" 29	11.50	" 29	11.58

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	....
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 23	4.40	July 18	4.40
" 24	4.40	" 25	4.40
" 25	4.40	Aug. 1	4.40
" 26	4.40	" 8	4.40
" 27	4.40	" 15	4.40
" 28 Sunday		" 22	4.40
" 29	4.40	" 29	4.40

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	....
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	....
Mch.	72.56	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Aug. 23	4.65	July 18	4.76
" 24	4.65	" 25	4.72
" 25	4.65	Aug. 1	4.75
" 26	4.65	" 8	4.70
" 27	4.65	" 15	4.72
" 28 Sunday		" 22	4.70
" 29	4.65	" 29	4.65

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.11
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	....
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Aug. 2	47.50	Aug. 16	47.50
" 9	47.50	" 23	47.50
		" 29	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	....
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

THE PRICE OF LIBERTY BONDS

Richard H. Tingley, writing in 'American Industries', sums up the situation in relation to the holding of Liberty bonds that certificates seem to be refunding themselves in a certain way, according to calculations, as they will now purchase three or four times the amount of any commodity they could buy in the year 1917. He says:

"A very general feeling of dissatisfaction exists in the public mind at the present status of the Liberty and Victory Bonds. Issued under the compelling emergency of war and subscribed to at par by more than twenty million people under the hurrah of enthusiasm and intensive campaigning, the situation has since been transformed from a patriotic to an economic problem. Holders of these various issues have seen their apparent value gradually fade away and are frankly disappointed. An impression prevails that the Government should do something to restore the value of these bonds and many suggestions have been made looking to this end—all having in mind some form of refunding the several issues into a single long-term bond bearing a higher rate of interest.

"One of the simplest and apparently most reasonable suggestions offered is that a United States Sinking Fund Bond bearing 5% interest and maturing 100 years hence will solve the question. The interest rate might appear high for a nation with the highest credit on earth, but it is contended that such a bond will command a par price at once in the market and that the burden of amortization will be distributed over several generations—as it ought to be. This plan has never yet gone beyond the bare suggestion and the details of working it out would be annoying, for the several issues command each a different market price today and will on any day.

"But why is any refunding operation necessary? The chief cause of complaint is that none of the bonds are worth in dollars as much as when they were purchased by the original holders. They have all depreciated in dollars value anywhere from 3% to 13%. But dollars have, in the meantime, appreciated in purchasing power of the things they will buy in a far greater proportion.

"The one hundred dollars you paid for your first 3½% Liberty Bond in June 1917 would have bought, if you had used the money for that purpose instead, only 333 pounds of copper at the then inflated price of that metal. Today, however, June 1921, even at the present depreciated money value of this bond ($88.60), and the depreciated price of copper, you could buy 738 pounds—more than double the old amount. Following the same reasoning, you might now buy 148 bushels of corn instead of 53 in 1917; or 1772 pounds of lead instead of 1000; or 98 pounds of wool instead of 67; or 738 pounds of rubber instead of 143—the purchasing power of your $100 bond in terms of rubber has increased more than five times. And so on down the list. The same story would be told if the list of commodities were extended to cover almost every essential and non-essential. Why then talk of refunding these issues on a higher rate of interest under any plan? No one questions the ability of the United States to pay the principal and interest when due, and in the meantime, there would appear to be no real cause for complaint. Your bonds are worth more than when you bought them."

MONEY AND EXCHANGE

Foreign quotations on August 30 are as follows:

Sterling, dollars:	Cable	3.71½
	Demand	3.72½
Franc, cents:	Cable	7.87
	Demand	7.89
Lira, cents:	Demand	4.39
Mark, cents		1.21

Eastern Metal Market

New York, August 24.

There is no activity in most of the markets; mid-summer dullness prevails.

Buying of copper is still light, but prices are steady.

Consumers have been fairly active in the tin market.

Demand for lead is reported as steady and prices are firm.

Improvement in the zinc market has not set in and prices are a little softer.

Antimony is nominally unchanged.

IRON AND STEEL

The hope of the steel trade that autumn will bring a noticeable increase in buying amounts to something less than confidence as yet, but there are indications of slowly expanding demand for some forms of finished steel, says 'The Iron Age'. The best ground for better expectations is an increase in the number of orders coupled with a more urgent call for early delivery. Producers of steel see more signs of the using up of stocks that have long stood between them and anything more than a hand-to-mouth operation, and are encouraged to look for a gradual decrease in the scale of their losses. The rate of steel-ingot production is slightly larger this week at several important plants. Central Western mills find more activity in automobile steel than in any other direction. The market for sheet metal is more active, some buyers making their first purchases in months.

The week has been an outstanding one in fabricated steel. Upward of 12,000 tons was placed and nearly 20,000 has been added to active pending projects, not including 14,000 tons for the Federal Reserve Bank in New York. Railroad bridge and building work is conspicuous by its absence.

The pig-iron market has held the improvement of last week, considerable sales being reported at 50c., or more, above recent low prices in some districts, while other business was closed at prices quoted a fortnight ago.

COPPER

Sellers report almost no improvement. Interests which are willing to meet the prevailing demand, light as it is, at 11.75c., New York, or 12c., delivered, for electrolytic copper for early delivery, report a fair business but it is light at the best. It is believed that consumers are gradually depleting stocks with the manifestly better demand that is slowly appearing and that buying will be necessary soon. It is felt that the market has reached bottom and that the metal is a good buy at present. Foreign demand is fair with Japan a consistent purchaser. In recent weeks several thousand tons has been sold to that country and it is reported that Japanese interests are expecting to sell considerable copper wire for Far Eastern hydro-electric development. The Lake copper market is nominal at 12c., New York.

TIN

This market has been the most active of any. In the past week a total of at least 500 tons has been sold, mostly future shipment Straits. Consumers have been the largest buyers. Most of this business, however, was done last Wednesday, August 17, but about 100 tons was sold on Saturday. On other days, including yesterday and Monday, the market has been dull and nominal. The price tendency has been firm and there has been little change on any day, spot Straits yesterday having been quoted at 26.12½c., New York, the same as a week ago. London prices yesterday were practically the same as a week ago. Arrivals thus far this month have been 1785 tons with 3055 tons reported afloat.

LEAD

A fairly steady business is reported by most sellers, consumers being the principal buyers. Prices are exceedingly firm at 4.40c., New York, and 4.25c., St. Louis. The leading interest has not changed its quotation of 4.40c., New York and St. Louis, for two months, this level having prevailed steadily since June 23.

ZINC

The market is slightly weaker at 4.15 to 4.20c., St. Louis, or an average of 4.17½c. which may be quoted as the market for prime Western for early delivery. The metal can be obtained for this price although not on a large scale, but there is no doubt but that the 4.20c., St. Louis, price has been shaded.

ANTIMONY

The market is nominally unchanged at 4.50c., New York, duty paid, for wholesale lots for early delivery. It is felt by one seller that the market has reached bottom.

ALUMINUM

There has been no change. The leading interest quotes virgin metal, 98 to 99% pure, at 24.50c. per pound, f.o.b. plant, in wholesale lots for early delivery. The same grade from importers is available at 19 to 20c. per pound, New York.

ORES

Tungsten: The market is quiet and nominal at unchanged prices with the minimum at $3 per unit in regular concentrate.

Ferro-tungsten can be purchased at 48 to 58c. per pound of contained tungsten in lump form, guaranteed as to quality.

Molybdenum: There is no demand and quotations are nominal at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: Absolute stagnation prevails and quotations for high-grade foreign ore are nominal at 20c. per unit, seaboard. Importations have taken a decided slump, having been only 5028 tons in July as against 18,447 tons in July, 1920, and over 60,000 tons per month early this year. Total imports for the first seven months have been 297,403 tons against 234,989 tons to August 1, 1920.

Iron-Manganese Alloys: The market for ferro-manganese is firm at $65, seaboard, for the British alloy and $70, delivered, for the American. Persistent rumors that less than these prices from first hands can be done are impossible of confirmation. British sellers say they cannot sell under the price named. Demand consists of 200 to 300 tons from a Middle Western consumer besides smaller lots.

Spiegeleisen, 20%, is firmly held at $26, furnace, but inquiry is light.

Ferro-silicon: Demand for carload lots is all that is reported, for which a minimum of $65 per ton, delivered, is reported as the bottom.

Many people will be surprised to be told that on the average of 20 railroad stocks there has been practically no net change in price during the last year. In the middle of August 1920 the average price of the 20 railroad stocks most commonly used to measure market movements was about 73 and it is now about 72. The investor who bought railroad stocks a year ago would not have suffered as he would have almost certainly done if he had held industrial stocks.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.50 to 2.00
" " " " " carboys "	2.60 to 3.10
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	9.00 to 9.50
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.50 to 6.50
" powdered, in barrels "	5.75 to 6.60
" glass, ground, 30 mesh, cases, tin lined, per 100 lb	18.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	0.31
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per ton	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO_2, – ¾ % Fe), in casks, per ton	140.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.18½
" " " " granular " "	0.18½
" " " " powdered " "	0.19
" carbonate, calcined, in barrel lots, per lb	0.25
" permanganate, in drums, per pound	0.70
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.50
" bicarbonate of " "	3.50
" caustic, ground, 98% " "	6.50
" " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	11.50
" " " 2-in. "	36.25
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.70
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	19.50
" " " 14, single-braid, rubber-covered " per 1000 lb.	7.05
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " solid, per 1000	20.00
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	25.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb	9.00

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.00
" gelatine " " "	19.00
" ammonia " " "	18.00
Fuse, common, in case lots, per 1000 ft	8.50
" waterproof, triple tape, in case lots, per 1000 ft	10.54

FUELS

Coal, Utah steam, $4 at mine, plus $7.50 freight to California terminal points, in carload lots, per ton	11.50
Coal, blacksmith's, in carload lots, per ton	24.00
" " in small lots, per ton	27.00
Coke, in carload lots, per ton	26.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate " "	0.16½
Gasoline " "	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine "	0.42½
Brass sheets, half-hard and soft, per pound	0.28
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅞ by 2-in., per 100 lb	8.75
Nails and spikes (20d to 60d base), per keg	4.75
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	10.10
" cold punched " "	11.90
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, per 100 lb	5.50

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.75
Rails, steel, 8 to 25-lb., per 100 lb	3.99
Reinforcing-steel, per 100 lb	3.75
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.80
" flat " " " "	6.70
" flat, black iron " "	5.90
Structural T's, channels, angles, and beams "	3.85
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	6.75
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	13.30
" " galvanized " " "	16.70
" " black " 4-in. "	58.00
" " " extra strong " "	113.75
Shafting, cold-rolled (2¼ to 3-in. base) "	5.50

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
" " extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	80.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White pine " " " "	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb. cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.00
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.15
" " " 2 (standard), per pound	0.14
Packing, flax, per pound	0.33 to 0.85
" sheet "	0.25 to 1.00
" steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	35 00
Tube-mill pebbles, Danish, selected (in bags), per long ton	30.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.00
" sheet, 36 in. by 84 in., No. 9 gauge, in ton lots, per 100 lb	14.85

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots	60.70
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	3.25
Portland cement, in bags, per barrel of 380 lb	4.20
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	5.50
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	12
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 7c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump, white, per ton	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn	5
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

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T. A. RICKARD, - - - - Editor

NOW that the Mexican Supreme Court has decided that the Constitution of 1917 is not retroactive, and has enjoined the Executive from confiscating foreign oil property acquired before May of that year, it is expected that a way will be found for arriving at such a friendly settlement between Mexico and the United States as will lead to recognition of the Mexican government by the Administration at Washington. We hope so.

PROSPECTORS generally appear to dislike the proposed revision of the mining law, and mining engineers seem unwilling to defend it. The bill to codify and revise the mining laws of the United States has been introduced in the House of Representatives by Mr. Samuel S. Arentz, of Nevada. We happen to know that he is a subscriber to our paper and that therefore any criticisms we publish will be seen and considered by him. Mr. Arentz invites objections, criticisms, and suggestions, as it is his earnest desire that the proposed legislation shall be to the enduring benefit of the mining industry.

AMONG the valuable publications issued by the U. S. Geological Survey we esteem none higher than the 'Suggestions to Authors', by Mr. George McLane Wood, editor to the Survey. When the first edition of this useful little book appeared in 1888, we greeted it 'with cheers', as it were, and recommended it to the members of our profession, more particularly to the mining geologists, to whom it makes personal appeal. A fresh imprint has just been issued and we note that "additional copies may be procured from the Superintendent of Public Documents, Government Printing Office, Washington, D. C., at 15 cents per copy". *Verbum sap.*

FROM time to time the world is informed that somebody has re-discovered the lost art of tempering copper, making the metal hard enough for cutting other metals. The latest story is that the United States Steel Corporation has paid a million dollars to an inventor for his formula. This has been denied by Judge Gary, the chairman of the Corporation. It has been assumed by many that the ancients knew how to temper copper, whereas the fact is that the copper they made was harder only because it was impure. The 'art' of tempering copper never existed. Every once in a while some blacksmith comes forward with a claim to the re-discovery, but it is a mistake on his part, and sometimes on the part of his backers. The alloys used for manufacturing modern high-speed tool-steel are far superior to anything that could result from the tempering of copper, and incomparably cheaper. The canard deserves a quietus.

DISARMAMENT is nothing new; all that is needed is a broader application of the principle. Some time this month a Peace Portal across the Pacific Highway will be dedicated at the boundary of the United States and Canada. That the two great English-speaking neighbors, divided only by an unfortified frontier, can live in harmony for a hundred years or more augurs well for disarmament on a larger scale. If the United States and Great Britain can come to a complete understanding on this point, the other nations of the world must follow suit. No revival of industrial or national prosperity is possible until world disarmament is an accomplished fact.

IN its monthly review of general industrial conditions, the Guarantee Trust Company says: "In any long view of the future, aid for the restoration and stimulation of world markets would be far more to the advantage of the United States than a selfish and short-sighted drawing away from foreign difficulties. To us it is plainly a mistaken belief that to wall-in our industries behind a tariff will cause them to flourish. As imports are excluded the cost of living would not have the wholesome corrective of reasonable foreign competition and, further, the loss to our merchant marine would surely have its reaction upon taxation." With this we agree. Incidentally, we may mention that the gentlemen of the Guarantee Trust Company of New York are neither philanthropists nor Sunday-school teachers, but hard-headed and patriotic men of business.

ANCHORAGE, the terminus of the Alaskan central railroad from the coast to Fairbanks, is being mentioned in the daily press as the scene of recent gold discoveries, said to have been made in the course of grading for the railroad. This is *à la mode de* Cobalt, and we hope it will prove as important as the discoveries that led to the widespread development of Ontario. We would be delighted to have these reports confirmed, for the opening of a new goldfield in Alaska would be the best possible thing for mining at this time. Meanwhile we are sceptical, because the accounts lack verisimilitude. The latest 'Associated Press' dispatch says that "many

strikes have been made in the rock-cuts blasted out of the precipitous walls of the Turnagain Arm division of the United States railway between Seward and Anchorage". It is asserted that "values ranging around $25 per ton were found in veins twenty odd feet in width". This is journalese in place of the simple statement that an assay of $25 has been obtained on a sample taken from lode-matter 20 feet wide. As one swallow does not make a summer, so one good assay does not turn rock into 'ore'. Again, it is stated that "while some veins show free gold, the major portion of them indicate what is known as cyaniding ores, necessitating concentration". It would be well if the 'Associated Press' selected as its representative in a mining region somebody who knows something about mining and milling; who knew, for example, the difference between cyanidation and concentration, between magnetic and magmatic, between cyanide and syenite, between alaskite and holdmetite.

THE extended use of concrete as a lining in tunnels and in mine openings is indicated by the construction recently completed by the Southern Pacific Company in the Tehachapi mountains. The railroad was built in 1876; 40 years afterward it was evident that the increase in traffic was such that the enlargement of the tunnels was imperatively necessary. Much trouble had been caused during the intervening time by fire and caving; and heavy losses were incurred. This particular stretch of railroad, 48 miles long, is one of the busiest single-track lines in the country; it is operated jointly by the Southern Pacific Company and by the Atcheson, Topeka & Santa Fe Railway; it runs from the floor of the San Joaquin valley to the summit of the Tehachapi mountains. In the busiest time of the year as many as 87 daily trains have been operated over the section, and as many at 1287 freight-cars; the daily schedule is 14 passenger trains and 8 freight trains. The tunnels, of which there are 18, were of small bore, except for a section of about 1000 feet in solid rock, and were lined with timber. In 1916 it was decided to enlarge them to a minimum horizontal section of 16 feet on the tangent and 17 feet on the curve, with a minimum overhead clearance of 22 feet. The adoption of reinforced concrete throughout provided a solution of the problem of tunnel fires and caving. The pneumatic method of construction was used, whereby steel frames, 20 feet long, were erected on tracks. These maintained the lining in position until it was set, the concrete being delivered from a montejus to the space above and around the frame by means of compressed air. When a section was complete, the frame was moved forward along the tunnel, and the operation repeated. When the members of the operating staff had become accustomed to the work, a rate of progress that amounted to 100 feet per week was maintained. About 6000 feet of tunnels has now been lined, the operations involving the use of 110,000 sacks of cement, 1,500,000 linear feet of reinforcing steel, and 45,000 tons of aggregate. The value of permanent work of such a nature cannot be over-estimated.

In San Francisco

Much has been written recently in our local press about the tyranny of labor and the corruption of the labor-unions, but everybody cognizant of the facts and willing to recognize them knows that the blame for the disorganized condition of industry in San Francisco belongs to both sides—to the employer as well as the employee, to capital as well as labor. A few days ago the directors of the Panama-Pacific Exposition of 1915 had to explain why they had given the printing of the official history of that exposition to a firm in New York. It appears that G. P. Putnam's Sons did it for $30,875, whereas the local printers demanded more than $50,000. It is also a curious fact that the four bids made in San Francisco were very close, ranging between $52,503 and $54,260. Was that a strange coincidence? Not at all; it is explained by the existence of a combination, the Printers Board of Trade, that kills honest competition. The first man to be asked for an estimate claims his victim and no member of the combination is allowed to submit a lower estimate. Similar conditions obtain among employers in other local industries. Chicanery undermines fair dealing. If, for example, the price of labor or of raw material is increased 10%, the manufacturer passes the burden on to the consumer; and not only does he do that but he takes the opportunity to profiteer outrageously. The increase in labor or raw material may represent only 2½% of the *total* cost of the product, so that the remaining 7½% is added arbitrarily under cover of a necessary re-adjustment. The labor-unions are ineffective because they cannot maintain their solidarity, and their failure to act as a unit is due first to their inability to persuade all the workers to join, and second to the corruption of their leaders, many of whom make terms with the combination of employers. Industrial adjustments are vitiated by 'politics', that is, deals and bargains of an underhand kind, involving disloyalty on both sides. Thus when the printer employees made their outrageous demand of a 48 hours pay for 44 hours work, the printers were unable to take a firm stand. Nearly half capitulated at once and the others held together for a few days only, having neither the courage nor the loyalty to resist an imposition of the gravest kind. Is it any wonder that Los Angeles attracts the manufacturer? It is all well enough to 'boost' San Francisco and to raise money for 'bull' campaigns, but what San Francisco needs is honesty among both its workers and its employers; it should establish and maintain a real system of collective bargaining, not a miserable vendetta varied by graft and trickery galore. The spirit of the days of Schmitz and Ruef survives; the briber is still deemed better than the bribed; a demagogue still sits in the mayor's chair and the whole system of public control is rotten from top to bottom. Instead of building bridges on paper and trying to advertise San Francisco with flapdoodle, it would be well if our people realized that local industrial and individual prosperity depends upon fair dealing and honest work, not upon double-dealing and sculduggery.

Valuation of Placers

In this issue we publish an article that is of particular interest because it discusses a subject that has not been accorded the attention it deserves, namely, the estimation of the value of alluvium containing gold and platinum. The author is Mr. Gerald H. Hutton, whose wide experience as a dredge operator gives his opinions more than ordinary weight. The estimation of the precious-metal contents of a placer involves, first, the sampling of the ground, and second, the interpretation of the results of such sampling. That erroneous conclusions have been reached frequently in this work is indicated by the number of dredges that have been abandoned long before the anticipated yardage has been mined, and by the still greater number of dredging enterprises that, after years of active operation, have barely returned the capital investment without any reasonable profit to the owners. As Mr. Hutton points out, the ingenuity and resourcefulness of dredge-engineers has been directed toward mechanical improvements and refinements with the object of reducing the cost of operation and increasing the recovery of precious metal. In this they have been remarkably successful. In the modern dredge, wood has been replaced by steel for the construction of the hull and a large part of the superstructure; the size of the buckets has been increased to such a degree that as much as 15,000 cubic yards per day can be excavated by a single machine; the design has been perfected, and superior grades of manganese-steel have been used in bucket-lines and tumblers, with the result that the dredge can eat its way through almost any material except solid rock or cemented conglomerate. In their efforts to reduce the operating cost, dredge-men have adopted heat-treated alloyed steel for bucket-pins and similar parts; they have taken advantage of the economies effected by welding with the oxy-acetylene flame and with the electric arc, and by using the oxy-acetylene torch for cutting metal; they have systematized and standardized their operations to the point where, as Mr. Hutton declares, dredge-mining can be done under favorable circumstances for as low as 5½ cents per cubic yard. We venture to add one highly essential factor to those enumerated by Mr. Hutton as accounting for a remarkably low operating cost: competent and efficient management. The omission was probably intentional, and perhaps excusable, for the reason that Mr. Hutton is well known as the engineer who is directing the three successful dredging enterprises of the Metals Exploration Company at Gold Canyon, in Nevada, and at Marigold and Junction City, in California. The good work done in reducing the cost of operation serves to emphasize the apparent neglect of the pre-requisite to profitable exploitation, namely, the ascertainment that the deposit under consideration is sufficiently rich in gold or platinum to warrant the investment of the capital necessary to mine it. Although the general principles applicable to the appraisement of any mining property are not dissimilar, the task of sampling and valuing dredging ground accurately has inherent features that make it difficult. Mr. Hutton points out some of these features; he gives concrete examples to show the wide variation between the anticipated and realized recovery from specific blocks of ground; and he presents in detail his method of adjusting the data derived from drilling reports, and computing the unit-value of the ground. He declares frankly that he is not yet satisfied with the procedure, and urges other engineers to contribute their ideas and the results of their experience, to the end that better methods may be developed. Such an exchange should benefit all; we welcome discussion of Mr. Hutton's paper.

The Making of a Career

The mining profession is remarkable for the variety of men it includes and the diversity of the training that they have undergone. As all roads lead to Rome, so all kinds of preparation seem to have sufficed to develop the character and stimulate the ability of the young engineer to such a point as to open the portals of a successful career. Presumably the correct inference is that force of character cannot be gainsaid if opportunity be given. The many interviews that we have published show that the leaders of our profession have been most variously, and, sometimes it may seem, unequally educated, in so far as a conventional curriculum is implied: yet the inequalities of the start—the varying handicap, as it were—have failed to hold back the genuine men, the hard workers and honest thinkers, the true votaries of science as applied to industry. We have recorded conversations with those who were graduated from famous colleges and with those who as boys thought themselves lucky if they could get hold of an occasional textbook for reading during the intervals snatched from manual labor. Not many of our subjects have been graduates from recognized mining schools; partly because the School of Mines as an institution for preparing mining engineers was only just becoming established when our veterans were boys. Nowadays every civilized country has a School of Mines, and we in the United States can boast one in each of the principal mining regions. Among these is the Colorado School of Mines, which, despite its chequered career, has produced many useful men, among whom is Mr. James L. Bruce, whom we interviewed recently in his office at Butte, Montana. From Dublin to Butte does not seem a far cry, thanks to Marcus Daly and other Hibernians, but Mr. Bruce only happened to be born in Ireland, and it seemed extremely unlikely forty years ago that he would ever develop into a leader among mining engineers in Montana. He owed his liking for mechanics to his father; and to that parent's migratory life he likewise owed his first contact with mining, in Colorado. There he became attracted to the digging of ore by meeting those who were engaged in the industry at a time when the goldfields of Colorado, particularly Cripple Creek, were in the ascendant. Like other successful and useful men, he worked his way through college, that is, he earned the money needed for the purpose, interrupting the regular scholastic course in order to engage himself as a chain-man and

draftsman with a firm of surveyors at Cripple Creek. Such breaks in a college course may be a handicap in some ways, but they do serve undoubtedly to add to the seriousness of purpose with which the student renews his studies. Like everybody else he obtained his start through the kindness of a senior; we all did that; none of us was worth his salt when he started; somebody had to be a fairy godfather to us. Not everybody, however, remembers and records his gratitude, as Mr. Bruce has done, to those who gave him his first chance.

The surveying department is a good ante-room for mining engineering, if the young man be not too content to remain there, because it brings him in contact with operations underground and gives him an opportunity to study the geologic relations of ore deposits. Mr. Bruce seems to have had a persistent desire to avoid undue absorption in the purely technical work, but to acquire knowledge of the business of mining in its broadest sense, more particularly in connection with the management of men and the administration of affairs. For his flair in this direction he may be indebted to the Scottish factors from whom he is descended; at all events, he showed early a keen appreciation of the basic idea that the chief purpose of mining is to make money, not to test interesting processes or to investigate the origin of ores, neither to develop the waste places of the earth nor to spoil the scenery of the beautiful ones. This being his notion, he was fortunate in becoming associated with Mr. J. R. Finlay, who in practice and in theory, as his book on 'The Cost of Mining' proves, is a disciple of the truly utilitarian phase to which Mr. Bruce was an early and sagacious convert. Then he met another, and even more famous, exponent of the same school, Mr. D. C. Jackling, one of the great captains of our mining industry. That was a turning point in his career, and it was only eight years ago, yet since then Mr. Bruce has achieved a notable professional success as manager of the Butte & Superior. Of course, the introduction to Mr. Jackling and the offer that followed was one of the opportunities that make a man's career. The point is that Mr. Bruce was ready for the opportunity, and was quick to recognize it at its real significance. Our readers will be pleased with his unequivocal answers to our questions, particularly in regard to apex litigation, Minerals Separation, labor troubles, and other matters of a delicate nature.

Mr. Bruce denies the pleasant story, often repeated, that the cost and annoyance of mining litigation at Butte has been much more than compensated by the large orebodies discovered in consequence of work done underground for the purpose of obtaining evidence for use in the courts. He gives a clear—and, we believe, fair—explanation of the cause of labor unrest at Butte, where the usual issue between capital and labor has been confused greatly by the rivalries and squabbles of opposing parties within the ranks of labor, this confusion being caused chiefly by the radical and irresponsible element typified by the I. W. W. Of the so-called welfare work he approves, and more particularly the current practice of giving employees some regular means of representation, whereby their just grievances and desires can be brought before the management; but he recognizes, as others experienced in such matters have done, that the mere bigness of the modern industrial enterprise, in mining as in other branches of organized human effort, tends to separate the employee from direct contact with his employer and thereby to spoil the human relationship on which effective leadership and successful cooperation may depend. Another change prejudicial to a mutual understanding between manager and men is the withdrawal of many of the native-born from mining, especially from work underground, and a proportionate increase in the foreign element. In some mines this involves the difficulty of speech, for many of the aliens do not speak English, and under such conditions it is doubly difficult to create anything like a good understanding with the working force. To cure this the night-school and the Y. M. C. A. must be supported and developed. Mr. Bruce speaks wisely, we think, on the subject of young college graduates undergoing the hard experience of manual labor in the mine with a view to qualifying as bosses. What he says needs no interpretation; nor does his sensible suggestion that our technicians should take a larger interest in civic and national affairs, in short, that they should realize their privileges as citizens. Undoubtedly Theodore Roosevelt ten years ago and Mr. Herbert Hoover today have quickened this impulse among the young men. Mr. Bruce himself, we happen to know, is a director of the Chamber of Commerce in his own city, so he appears to follow the advice he gives to others. That is characteristic; he is sincere. He is a man who does not waste words. Quiet and unassuming in manner, he suggests reserve power. As a young fellow he acquired unusual skill in surveying and mapping; that gave him his start; later he developed a keen sense of practical economics and thereby became a highly successful mine manager. He keeps closely in touch with everything that is going on; he is not a man of a dependent nature; he is progressive, and always on the look-out for any improvement in method or machinery; he is not prone to snap judgments, but looks before he leaps. The change from a big company like the Butte & Superior to a small affair like the Davis-Daly was a serious step for him to take, as he explains in the interview; he took it because he is enterprising and was willing to incur reasonable chances. That is the true spirit of mining adventure. He has shown his restraint in adapting the equipment of the smaller mine to the exigencies of finance; in short, he is a manager, not a mere speculator. One who knows him well says that he has a way of getting things done, and the ability to inspire cooperation. That he is loyal himself is suggested by his appreciation of loyalty in others. He realizes that to play a lone hand is a poor game; in short, he is a born leader of men. He is still much too young to be looking backward, he has a future in which at least as much can be done as in the twenty years of his past active and responsible work. We wish him continued success.

THE BUTTE & SUPERIOR MINE, AT BUTTE, MONTANA

James L. Bruce, of Butte

An Interview, by T. A. Rickard

Mr. Bruce, you are of Scottish origin?

Of Anglo-Scottish. The family home during my father's time was first at Shaw Farm in St. Quivox parish, and afterward at Rokeby House, near Prestwick, in Ayrshire, Scotland. My mother was born in Ireland, her father, William Latimer, being of purely English, and her mother of purely Scottish, origin. My two sisters, my brother, and I were born in Dublin, Ireland.

When?

I was born on March 20, 1880.

What sort of an early education did you have?

I attended kindergarten in London, England, for maybe a year or a year and a half.

How did you happen to go to London when your home was in Dublin?

My father met with reverses of fortune during the panic of 1883 in Ireland and left for Ontario, Canada, to make a new home, during which time our family, with my mother, went to live with my mother's mother in London.

What further education did you have?

As a matter of fact, I had very little. Our family settled for a time on a farm near Haliburton, in Ontario, Canada, at a place without school facilities, so that the family's early education was confined to the home. My mother and an aunt from Scotland, who came to visit us for a time during my mother's illness, were our teachers. Later, when I was about nine years old, my mother having returned to my grandmother in London on account of very poor health, our home was made with cousins near Woodstock, in Ontario, where I went to a country school distant about a mile and a half from the farm upon which we were then living. I attended this school for about four years, after which my brother and I joined my father at Denver, in the fall of 1893.

What was your father's occupation?

My father spent many years, prior to the date of my birth, in Ireland, where he was engaged in the nursery, seed, seed-implement, and fertilizer business. He traveled through Ireland as a commission agent, handling the above and related mercantile lines, during a portion of this period. By the way, he was the inventor and patentee of special machinery used in the separation from each other of different species of grass seeds and in the elimination at the same time of weed seeds, machines of this make being supplied to several foreign countries, including France, Italy, Germany, and Austria.

So that is where you got your feeling for engineering?

I presume this is to some extent responsible. All my paternal ancestors on the Bruce side, as far back as my great-great-great-grandfather (1719), were Scottish estate-factors, and as such were necessarily engaged more

or less in land-surveying, building of farm-steadings, road-making, and such work, but not one of them was a trained engineer in the modern sense. William Murdock, the inventor of gas-lighting and of several improvements to the steam-engine, was a member of our family, although I do not know the exact relationship. He was also, I believe, the first to install steam-engines in connection with mining, at Redruth, Cornwall, and was a partner of Boulton & Watt, of which firm James Watt was the inventor of the steam-engine. My maternal grandfather, William Latimer, an Englishman, was a civil engineer and was killed by a fall from his horse while engaged in building the first line of railway from Dublin to Belfast. His father-in-law, Thomas Millie, was also a civil engineer and died at Brockville, in Canada, while assisting in the construction of the Grand Trunk railway.

What took your father to Denver?

My father, soon after my mother's departure for London, removed to Florida, engaging for a time in the brick-making and mercantile business, and later went to Denver, where he established a business, which was transferred to Cripple Creek immediately after the great fire which destroyed that place in 1896.

Well, I can see that you were getting nearer the mines.

Although originally my father's business and not the mines had brought me to Colorado. While in Denver I attended the grade schools, and owing to unfamiliarity with United States history and other courses, it was necessary for me to start in the sixth grade. My advancement, however, due to my Canadian school training, was fairly rapid, and despite irregular attendance I was able, after going to school in Denver for a little more than two years, through the assistance of my brother, who had had more schooling, to prepare for entrance to the Colorado School of Mines, examinations for which I was successful in passing in 1896.

Your brother had preceded you at the Colorado School of Mines?

Yes. He had completed most of his high-school course and had finished one year at the School of Mines at the time of my entrance.

What is your brother's name?

Stuart S. Bruce. He is now at Victoria, B. C.

So you graduated from the Colorado School of Mines, Mr. Bruce?

Yes, I graduated in 1901, after having attended for the freshman and sophomore years, and thereafter remaining out for one year, during which time I assisted my father in his grocery business at Cripple Creek, to which he had removed from Denver a year previously.

So now you were actually among the mines.

Yes.

What are your first impressions of the mines? Were these the first mines that you had seen?

I had seen some of the coal and clay mines in the neighborhood of Golden before going to Cripple Creek, but had no familiarity or experience with metal mining, and, as a matter of fact, my intention when I first went to Golden was to take the electrical engineering course, which was also included in the curriculum at that time, but coming in contact with mining people from various parts of the State and from other places created an interest in the mining industry which lead me to take the mining course, this determination being made toward the end of my freshman year.

Why did you discontinue your work at Golden?

After having completed the sophomore year I found that my finances were insufficient to see me through the complete course and I found it necessary to go to work for a year and raise the necessary funds.

How did you do it?

I joined my father at Cripple Creek, taking up as much work as I could secure along my professional line, in assisting the mine surveyors and engineers of the district.

With whom did you work?

My first employment was with E. P. Arthur, in making the location of a mining claim called the 'Neversweat'.

That seems to be ominous of Butte.

Yes, and I might add that the Neversweat claim was located on one of the hottest days ever seen in the Cripple Creek district. I also assisted Haff & Colwell, and, if I recall correctly, probably assisted, on one or two occasions, the firm of Hills & Willis, who were among the first engineers in the Cripple Creek district. I feel grateful to the members of the profession in Cripple Creek who gave me this first opportunity to get a start.

Then you went back to Golden and completed your course in 1901. After graduation where did you go?

My brother in the meantime had been employed by the Arkansas Valley smelter at Leadville as an engineer and through his good offices my first position was secured with Charlie Taylor, who had the contract for doing the assaying for the Ibex Mining Company.

The Ibex Mining Company operated the Little Johnny mine, did it not?

Yes, and this mine was one of the important producers of the Leadville district at that time. Mr. Taylor had the contract for all their work, at a flat price of $1000 per month, and through some development of friction in the organization, the shift-bosses and foremen were trying to overload the assay-office with samples. It is probably of interest to inform you that during one month we made more than 24,000 determinations for gold, silver, lead, zinc, manganese, copper, and silica, at an expense to the mining company of $1000.

How many of you were there in the assay-office?

There were, altogether, including the men who prepared the samples, seven men.

How long did this contract remain in operation?

Until after my departure; but the tremendous number of determinations gradually decreased in the four

How much did it cost you to live?

Probably about $50 per month for the necessaries. I had no rent to pay.

CRIPPLE CREEK, COLORADO, IN 1900

or five months during which I was employed there, to about 15,000 determinations—not samples.

How many determinations were made per sample?

Well; sometimes one, sometimes two, sometimes five or

Why did you quit?

In the fall of 1901 I had an invitation to take a position that seemed to offer better opportunities, with the firm of Hills & Willis in Cripple Creek, as drafts-

THE AJAX MINE AT CRIPPLE CREEK

six. The average number of determinations per sample was probably about three.

What were you paid?

My average earning per month was between $80 and $85.

man and assistant to the surveyors and engineers, at a salary of $100 per month.

This gave you a good opportunity of becoming acquainted with the geology of the Cripple Creek district?

Yes; while I was principally occupied in drafting and

platting of survey-maps, there were many occasions on which I was taken into the field, when I had an opportunity to gain experience in the practice of mining and in the operation of the mines and the geological side of the profession. I also had quite a little experience in the preparation of exhibits and assisting with examinations preparatory to apex litigation.

Do you not think that the surveying department is a good ante-room for a young mining engineer?

I think it is, provided the engineer doesn't develop, as frequently happens, a sense of satisfaction with this comparatively independent position, which will cause him to avoid the operating and clerical departments, thus depriving him of much of the experience that would equip him with qualifications for an executive position.

How long did you remain at Cripple Creek? Were you there during the big strike of 1903, and can you say anything about it?

I was assisting Mr. Hills in an examination of the Dead Pine mine, which connected with the Gold Coin workings, and we were engaged in that work at the time an explosive trap was discovered on one of the stations of the Gold Coin shaft. The railroad station at Independence had been dynamited, the militia had been ordered to the district, and a semblance of order had been established. The Gold Coin organization had discovered a box of explosives that had been arranged to cause a wreck of the shaft and station by a trigger so set as to be operated by the passing of the cages. The discovery of this probably brought about the more effective guarding of the properties of the various companies. Additional militia were ordered to the scene of trouble. I remember well that one or more machine-guns were trained by the militia on the approaches to the building in which our offices were located in Cripple Creek, as a protection to the Court in session in the same building, which was opposite the National Hotel.

What view do you take now in regard to that particular industrial trouble?

As I recall it, this was a strike that was called for the sole purpose of expressing sympathy with certain strikers at the mills of Colorado City, and I think that there was no grievance with the conditions at Cripple Creek itself, and as various acts of violence had taken place it seems to me that it was essential that peace be restored by armed force. One of the factors in the situation was the bellicose attitude of Sherman Bell, who commanded the militia. He seemed to be devoid of any sense of tact, and provoked unnecessary ill feeling by his truculent behavior. The ultimate outcome, however, was a co-operation of the mining companies in an employment agency, which probably brought about a more generally satisfactory contact between the employers and the employees than had previously existed.

Would that include the black-listing of the unruly or the anarchistic?

As to that I cannot say.

How long did you remain at Cripple Creek?

I left the Cripple Creek district in April 1904, in order to take a position with the Federal Lead Company in south-eastern Missouri. This enterprise was then under the general management of J. R. Finlay, with whom I had previously become acquainted when he was general manager for the Portland Gold Mining Co. at Victor, in the Cripple Creek district. I had assisted Mr. Hills in preparing his portion of the annual reports of the Portland and had also given special assistance to F. L. Ransome and Waldemar Lindgren in the report that they made on the Cripple Creek district for the U. S. Geological Survey, and no doubt was suggested for the position by Alfred Rock, with whom I had become friendly while he was employed by the Survey at Cripple Creek, and who had accepted a position with the Federal Lead Company before I went there. I also became a friend of L. C. Graton, who was assisting Ransome and Lindgren. I recall with pleasure the many good friends I made at Cripple Creek.

While at Cripple Creek did you go to any other mining centres?

I accompanied Mr. Hills as his assistant on an examination that he made of the Lustre mine at Magistral, near Inde, in Durango, Mexico. Inasmuch as this mine was about a hundred miles from the railroad terminus at Rosario and in a community of about 1200 people, with only 10 English-speaking people, it proved to be of unusual interest. The property was owned principally by Pittsburgh people and was under the management of Walter Koch, a delightful gentleman, who made the occasion a pleasant one in spite of the discomforts of a hot climate and an existence without such commonplaces as milk, butter, or eggs. A peculiarity of the property was that the ore was self-fluxing, and of a pyritic character, so that by semi-pyritic smelting there was produced a copper matte, which was shipped to the American Smelting & Refining smelter at Aguascalientes for further treatment.

So then you went to Missouri?

Yes. I accepted a position as engineer for the Federal Lead Company, although the compensation was considerably less than I had been earning at Cripple Creek.

How much?

I was earning $150 per month, and accepted the new position at $100 per month, as I was especially desirous of coming into more direct contact with the actual conduct of operations than my opportunities as a surveyor afforded with the engineering firm at Cripple Creek. I was an admirer of Mr. Finlay's capability as a mining administrator and was very glad to have the opportunity of working with him.

What was the nature of the mining operations?

At that time the scale of operations of the Federal Lead Company was not a large one and the property had not been developed to the point of profitable or large production. The ore deposits consisted of galena dis-

UNDERGROUND IN THE CONTINENTAL MINE, AT JOPLIN

THE CONTINENTAL MINE, AT JOPLIN, MISSOURI

seminated through limestone at depths ranging from 200 to 500 ft. The ores were concentrated on jigs and tables, the concentrate being shipped and treated at a smelter near St. Louis.

Did you remain long at Flat River?

I remained there until March 1907, first in the capacity of engineer and after six or eight months as general mine-foreman, a position that brought me into intimate contact with the mining and milling operations. Mr. Finlay left a few months after my arrival and the management devolved upon T. F. M. Fitzgerald. During my employment as general foreman the properties of the Central Lead Company were purchased by the Federal Lead Company and a comprehensive program of new development and construction was undertaken, including the erection of a new concentrating plant. I was appointed chief engineer and co-operated in the erection of the new plant. I may mention that prior to this I was in charge, for a few months, of the diamond-drilling exploration of the company and so obtained a knowledge of that form of prospecting. It is interesting to recall that the mine shift-bosses at that time earned $2.40 per day, miners $1.90, pumpmen $1.60, machinists and blacksmiths $2 to $2.25, jigmen $1.75, mill-helpers $1.50, and surface laborers $1.30. The mill employees worked eight hours, and I believe the others worked ten hours per shift.

So your stay at Flat River was useful to you in enlarging your experience?

Yes, and also in increasing my friends among members of the profession. H. G. Washburn, who is now manager, came there at my invitation, as locating engineer for the Lead Belt Railway, which is owned by the Federal Lead Company and which at that time was being extended under my direction as Chief Engineer. This railway is one of about fifteen or twenty miles trackage; it serves to transport ore and supplies between the mines and mills and the Mississippi River & Bonne Terre Railway. L. G. Johnson, who at that time was my First Assistant, is also still in a responsible position with the Federal Lead Company. Tom Hackwood, who was Mill Superintendent at the time I went there, later became Assistant Mill-Superintendent at the Butte & Superior during my management. His son, Arthur, who as a boy helped me with the surveying at the Federal, completed the mining course at Rolla and became Chief Research Engineer at the Butte & Superior. W. S. Grether, who was also employed in the engineering department of the Federal Lead Company, after various experiences in other fields, again joined my forces at the Butte & Superior, and after taking charge of two or three outside operations for the company, now occupies the position of Assistant Mine-Superintendent. I greatly appreciate the loyal and capable support given me by all these friends.

While at the Federal it was my pleasure to establish a friendship with T. F. M. Fitzgerald, Corey C. Brayton, Frank Estes, H. A. Guess, C. V. Jenkins, Henry Krumb, E. G. Godshalk, H. A. Buehler, Allen H. Rogers, E. T. Stannard, and many others of the profession, the benefit of whose experience I have had on many occasions.

When did you leave Flat River?

In the spring of 1907. Upon Mr. Kirby's taking the management of the property I was not afforded the opportunity that I desired of again resuming a responsible place in the operating department. As I was offered a position about that time as assistant superintendent of the Grace Zinc Company, in the Joplin district, of which Mr. Finlay was President and General Manager, I decided to accept it and went to Joplin in March 1907. I remained as assistant to W. H. Gross, the superintendent of the Grace Zinc Company, for a little more than a year, and in November 1908, the property being nearly exhausted, I accepted a position as manager of the Nortonia Mining Company, also at Joplin. This connection, however, being unsatisfactory—

Why was it unsatisfactory?

On account of the failure of the officers to provide funds to pay the crew.

You are excused. I have known what that means.

As a matter of fact, the property was in debt when I took charge of it. Shortly after starting up, the bank deposits were garnisheed by creditors, and upon the officers of the company failing to provide funds for payment of the employees, I produced sufficient concentrate to pay the men and, after shutting-down the property, resigned.

Did you remain at Joplin?

Yes. Fortunately, within a few days thereafter I was invited to Boston for an interview with the officials of the Continental Zinc Company, who were then in need of a manager, Fred Jordan, the previous manager, having resigned to take a position in Canada. He is now with the Mesabi Iron Company and was at that time a good friend of mine, and in fact recommended me as his successor at Joplin.

Who controlled the Continental Zinc Company?

At that time it was controlled jointly by the firms of Ladenburg, Thallman & Company and Hayden, Stone & Company.

So this time you had good backers?

Yes, indeed. I think that this was the first mining venture of the Hayden-Stone organization, and for that reason they have always taken an interest in the property, which its size would not otherwise probably have justified.

What kind of ore deposits were they exploiting?

Their properties were producers of zinc and lead, occurring, in the case of the Litteral mine, as the well-known sheet-ground deposit of sphalerite and galena in chert layers within the limestone, at a depth of approximately 200 ft. By the way, we had some very low mining costs in connection with this property. In the face of difficulties encountered in pumping a strongly acid

water, and unusual milling expenses due to its destructive action on all metal work, our costs of mining and milling, including all general expenses, for a year's operations, in 1912, were a little less than 85 cents per ton.

What was the grade of the concentrates?

The lead concentrate averaged a little more than 80% lead, and the zinc concentrate about 57½% zinc.

Your production was concentrates? You did not treat either of the two concentrates yourselves?

No, this was sold to custom buyers, as is usual in the Joplin district.

Did you remain long with the Continental?

I was in charge of the Continental operations until March 1913. On February 1, I was given leave of absence to assist Mr. Finlay in a comprehensive examination that he was making of the properties of the St. Joseph Lead Company in the Flat River district, with which I had become familiar during my prior experience, and while so engaged was invited to a conference with D. C. Jackling, who was then developing the Butte & Superior property in Montana. I met Mr. Jackling and traveled with him in his private car from Kansas City to Topeka, and during the journey he suggested that I make a visit to Butte with a view to considering the management of the Butte & Superior.

What were your impressions of Mr. Jackling when you first met him?

I discovered very soon that he was thoroughly familiar with the technique of mining and in all respects a man of unusual capability. It appealed to me very much also to be afforded an opportunity to work for a man who would so thoroughly appreciate not only the accomplishments but the difficulties of the management of a mining property, and I had no hesitation, as soon as I learned that Mr. Finlay could release me without embarrassment, in coming to Butte to review the situation. This I did at the earliest opportunity, arriving in Butte some time during the latter part of February 1913, spending a few days at the mine and mill, after which I returned to make arrangements for my successor at the Continental Zinc, and to move my family to Butte.

When were you married?

I married Miss Mary Louise Temple, of Joplin, on June 16, 1909, and had the very sad experience of losing her on our fourth wedding anniversary, shortly after coming to Butte. On December 25, 1915, I married Miss Leah Sidney Hills, the daughter of my former chief, Victor G. Hills, of Cripple Creek. We have four children, two girls and two boys.

So you took charge of the Butte & Superior just about the time the flotation troubles began?

Yes. Shortly after the filing of the suit, which occurred in 1912. Mr. Hyde was still conducting experimental work at the Butte & Superior mill, but left shortly after my arrival.

Mr. Bruce, you had a great deal of experience in mining litigation of one kind or another, and the lawsuits both with the Minerals Separation company and the Clark estate must have added a great deal to your anxieties as manager of the Butte & Superior?

Yes, these controversies occupied a great deal of my time and attention and occasioned a lot of traveling and my attendance in each of the Federal courts.

Do you look upon these litigations as unnecessary evils? That is, do you think that either the apex suits or the flotation suits could be avoided if the laws were revised?

I think that the revision of the apex laws could be beneficial only to future mining locations, inasmuch as they could not be made retroactive, but I think nearly all of our profession are agreed that some modification of the laws should be effected for the benefit of future locators and their assigns. The advantages or encouragements afforded by the law seem to be very much more than offset by the uncertainties and tribulations arising from its interpretation. With respect to the patent laws, it seems to me that while it is certainly desirable to encourage invention through patent protection, there should be some limitation not now afforded by the law from monopolies that may be created thereby.

Do you think it is possible to effect a settlement with the Minerals Separation people so as to relieve the mining industry of the incubus of their harassment?

It seems to me that the situation has become so complicated and the disposition of the Minerals Separation Company to exact punitive penalties from alleged infringers so stubborn that there is little probability of a settlement. The difficulty of securing a satisfactory cooperation of the mining operators is also a serious obstacle. It really looks very much like an almost endless campaign of litigation, unless the royalties demanded by the Minerals Separation people are reduced to such a figure as will induce the mining industry to pay them on those processes on which they claim patent protection.

You suggest that the M. S. people might become more reasonable—that is, that they might become so reasonable as to cause mine operators to accept their royalties without further antagonism? Do you think this is likely?

My view is that further litigation will establish the weakness of their position, which will ultimately provide the industry with clear-cut methods of escape by means of non-infringing processes.

I think there is a good deal in what you say. Some of their basic patents will shortly be expiring and meanwhile the continued research is leading to the discovery of methods for avoiding even the alleged infringement of their patents.

I believe that the process used today at Ray, known as the oiled-air process, is not an infringement of the

M. S. patents. I think that this, with other known processes of highly efficient character, will not be found by the Courts to infringe.

It has been stated in print that the mining litigation at Butte has led to the discovery of important ore-bodies; indeed, that the discoveries have involved so large a tonnage of ore as to pay for the cost of the many litigations, but while I have been in Butte I have been told, by Professor Clapp of the School of Mines, for example, that this is not so, and that the amount of ore discovered does not begin to compensate for the money wasted in litigations. What is your view of this?

I think it is doubtful whether the discoveries of ore as a result of development litigation have repaid the cost of such development work. There may be a near approach to it in some cases, but I think it is certainly true that the entire cost of litigation has only in rare cases been re-paid by the discovery of ore. In the case of the Butte & Superior litigation there was probably very little ore developed that would not have been opened up in the regular course of events, so that the cost of litigation, to both parties, amounting to probably not less than a million dollars, was practically uncompensated.

While you were in charge of the Butte & Superior you had labor trouble of a serious character in Butte, affecting your own management, I suppose. Would you please state the origin of these troubles, and what you consider the best means of preventing their recurrence?

The labor troubles in Butte have been occasioned, in most instances, by jurisdictional disputes between unions, or by the agitation fomented by outside organizations. They have seldom arisen from disputes between employer and employees. The first troubles with which I am familiar in the Butte district arose in 1914 from mismanagement of the local officials of the Western Federation of Miners, which brought about dissatisfaction of the union members with their own organization and resulted in its being broken up by spontaneous opposition of the rank and file. Advantage was taken of this situation by the organizers of the I. W. W. and the other extremists to secure control of the unorganized opposition to the Western Federation. The maintenance of this control during the period of the War, due to lack of labor and high wages and lack of effective law enforcement, was easy.

But why should a squabble in the ranks of the union cause the men to strike, that is, to quit work?

Most of the strikes in this district have been brought about by intimidation of employees, who have not been afforded sufficient protection, and who have a natural reluctance to continue at work in the face of threats and abuses directed not only against them personally but against their families, because they do not align themselves with the malcontents.

Your explanation applies to the strike of 1914, but how about the more ugly troubles of 1917?

The same statement applies to that. This strike was fomented by an electrician by the name of Dunn, who, it is presumed, had financial support from the headquarters of the non-partisan league or the I. W. W., and this probably instigated by pro-German propagandists. The finances supplied him were sufficient to enable him to establish a newspaper in the district, which secured the support of all the radical element. Dunn, for a time, was successful in securing a large following and in organizing a gang that was efficient in conducting sabotage, and, after the strike-call, intimidating the great majority of the miners and craftsmen, who would have been satisfied with conditions if permitted to continue their employment undisturbed.

Was the alleged cause of this strike a quarrel between unions, or did it arise from complaints as to the manner of employment?

The principal demands of the striking miners included the recognition of the Metal Mine Workers' Union, known with certainty to be under the domination of the I. W. W. organization, demand for higher wages, abolishment of rustling cards, etc.; but inasmuch as the strike was called shortly after the declaration of war by the U. S. and about the time of the draft calls, it seems clear that it was undertaken in response to systematically organized propaganda to obstruct the preparations of the War Department. A scarcity of labor and an expansion of industrial activities, of course, brought a ready response to any demand for higher wages or shorter hours. Shortly after the call of the miners' strike, sympathetic strikes were called by the electricians, machinists, boilermakers, and blacksmiths. The Metal Mine Workers' Union was not, however, recognized by the operators, and practically all employees had returned to work within a month after the date of the strike call.

What further strikes of importance have been called?

On April 18, 1920, a strike was called by the local No. 8 of the I. W. W. The demands made at that time, however, were very clear evidence of the fact that the strike was not called with the expectation of reaching any agreement that would better the conditions of employees. Demands called for a minimum wage-scale of $7 per day for six hours work, and the release of all industrial and political prisoners, and other features which manifestly were not within the power of the mining companies to meet. No doubt the I. W. W organization at that time considered that there was a reasonably good chance throughout the United States of creating sufficient discontent to cause the initiation of revolutionary acts.

Do you think that the relations between managers and men at mines have improved or otherwise during your personal experience in the West?

I think they have improved. Of course, the tendency

of the growth of larger corporations has been to separate the employees from as direct contact with the management as they used to have in the earlier days, but within the past few years there has been a much better consideration given to the welfare of employees, improvement of their working and living conditions, provision for their representation, and the hearing of their grievances and suggestions. Nearly all of the larger companies, where the management does not come in direct contact with the employees, have well-recognized means of giving them representation.

THE DAVIS-DALY SHAFT

Have you noticed a difference in the composition of the working forces in regard to changes of nationality or race?

Since I came here in 1913 there have been appreciable changes in the relative numbers employed of different nationalities and in the average ages of employees. Most of these changes are such as would naturally have been expected as a result of the War. In March 1913, of all employees in the Butte mines, approximately 35% were native-born and 65% foreign-born, as compared with 33% native-born and 67% foreign-born in the fall of the year 1918. In 1913 the percentage of foreign-born employees who had become naturalized was about 54%, as compared with only 37% in the fall of 1918. The proportion of employees in 1913 under 30 years of age was about 40%, as compared with a little less than 30% in 1918. In 1913, of the total number of foreign-born, about 65% came from English-speaking countries, while in 1918 there were only about 45%, the decrease being no doubt due largely to the demands of the War. Aside from the English-speaking workers, the principal foreign-born employees come from Austria-Hungary, Finland, Italy, and Sweden, with a scattering from almost every other European country.

What opinion do you hold as to the advisability of college graduates working up from the ranks, that is, engaging in manual labor underground, becoming foremen, and so advancing to positions of greater responsibility? Do you think that it is well for college graduates to go through this experience? Is it good for them, and is it good for the industry?

That depends entirely upon the individual. Some

THE DAVIS-DALY MINE AND THE TOWN OF BUTTE

college graduates are so constituted, physically and mentally, that they pursue this course with credit to themselves and with benefit to the mining industry, arriving at positions of responsibility. Very many, however, are not so constituted as to survive the physical hardships of such a course without detriment to their mental progress, and I would not at all generally recommend this program. I think that a modest amount of underground practical experience would be of benefit to the majority of technically trained engineers, but in my experience the chief omission in their education is in business training, rather than in practical experience. I believe that contact with business men of experience and with business conditions can best be brought about in general by encouraging the graduate engineer to take a serious interest in matters of public and civic character.

Do you think that they ought to learn something of accounting, book-keeping, and economics, rather than thump a drill?

I think that this would usually benefit them more.

So you think, Mr. Bruce, that our young engineers should show a greater interest in civic and national affairs?

Yes, I certainly do. I think that they need more contact with men of experience in business methods and the advantages of the second-hand experience that would be gained by such contact. This can best be acquired by active interest and attendance at the meetings of organizations of a civic or business character, such as Chambers of Commerce, School Boards, Y. M. C. A.—in fact, any well-organized institution that performs its functions in a systematic or parliamentary manner.

Returning to your own career: How long did you remain with the Butte & Superior as General Manager?

Until January 1, 1920. In the middle of September 1919, I accepted the management of the Davis-Daly Copper Company, and acted as manager for both properties until the end of the year, at which time my resignation as manager of the Butte & Superior became effective.

Why did you resign?

There were several reasons: In the first place, I had an opportunity to take the management of the Davis-Daly at an attractive remuneration, and, in the second place, I was desirous of obtaining new experience in the copper industry, after having spent some years in the mining of lead and zinc ores. Furthermore, the amount of my attention that had been required by the comprehensive litigation of the Butte & Superior had become distasteful, and, while my associations and responsibilities as manager of the Butte & Superior had at all times been extremely pleasant, the new opportunity appeared to offer a chance for experience in a fresh direction.

I am glad to hear that you think you can escape litigation anywhere in the Butte district!

Well, I don't think that can be assured!

While you were with the Butte & Superior you examined a good many mines in various districts, did you not, for that company?

Yes, I made a number of examinations, and some of the properties were taken over and operated for a time. Among those operated were the Hudson Bay Zinc Co., near Salmo, B. C.; the Metalline Falls Zinc Co., near Metalline, Washington; and a large group of leases and options directly north-east of the Picher Lead Company's holdings in the Miami district of Oklahoma. I also examined the Interstate-Callahan, the Success, and the Black Horse properties near Wallace, Idaho; a zinc property in Inyo county, California; copper prospects on Valdez island, B. C.; and a number of properties in Montana. I also acted for a time as consulting engineer to the American Zinc, Lead & Smelting Co., and made examinations of their properties in the Joplin and Granby districts, Missouri, and at Mascot, Tennessee. At this time I became well acquainted with H. R. Kimball, J. N. Houser, H. I. Young, W. F. Rossman, and W G. Swart, who have been my good friends and counselors since.

Do you believe it to be a wise thing to perpetuate the organization of a mining company by the acquirement of new property, and also for a company to spread its activities so as to average its risks?

Yes. Any well-organized mining company is in a position to utilize its existing organization with comparatively small additional expense as compared with a new organization, and with much better efficiency, in taking up new properties that may show promise. As to the spreading of risks, although it is worthy of consideration, it doesn't appeal to me so strongly, as I feel that the individual stockholder, unless altogether uninformed as to the character of his investments, can spread his own risks by investments in the stocks of various non-attached mining companies.

Is the Davis-Daly Copper Company an old enterprise?

As a producer of consequence it has existed only since 1915, but following its date of organization, in 1907, an active program of exploration and development work was conducted. The principal orebodies, however, were not discovered until considerable depth had been reached.

How deep?

The first really important discovery was made at about 2500 ft. This ore has been followed to higher levels and has been the chief source of production since its discovery. Little development below this depth has been done, and the deepest development of ore at this time is on the 2700-ft. level, the shaft being 2850 ft. deep. The 2700 level, however, is equivalent to a depth of nearly 3200 ft. in some of the shafts situated on higher ground.

Do you think that the difference in elevation affects the nature of the ore deposits?

I think that the ore deposition in the deeper levels of the Butte mines is not affected by the surface contour.

I come to this conclusion from the fact that the oxidized surface ores persist to less depth at the lower surface than at the higher, and observations seem to show that the rock temperatures are about the same at the same horizons irrespective of surface elevations.

You have a cheerful feeling as to the future of mining in Butte, despite the present depression?

Yes, I can see no reason why the orebodies should not be mined as deeply as is possible within the limits of economy. Of course, as the temperature increases and ventilation becomes more difficult and hoisting more expensive, richer ores will be required to meet the cost.

What is the depth of the deepest workings, and what is the temperature at that depth?

The deepest shaft is the Steward, of the Anaconda Copper Mining Co., which is now 3633 ft. below its own collar and 3838 ft. below the collar of the High Ore shaft, with which it is connected. The deepest ore developed is about 75 ft. above the bottom of the Steward shaft and at an elevation of 2354 ft. above sea-level. In the deeper levels of the Butte mines when they are first opened the rock temperature is about 103° to 104°, and in some cases up to 110°F. Some rock temperatures in the district are considerably higher than this, but only in the vicinity of underground fires.

The persistence of ore in the Butte district has been remarkable. You consider the prospects are still good for further persistence? Of course, by ore I do not mean vein-matter, but mineral that can be exploited at a profit.

Yes; I know of no district in which there is greater probability of continuance downward of the orebodies. Of course, not all ore-shoots have continued to go downward, but the number and importance of ore-shoots at the greater depth does not seem to diminish.

You have done some interesting work at the Davis-Daly, as I happen to know. Would you say something about your octagonal shaft?

We have just completed a unique shaft, exclusively for ventilation. This was raised from existing underground levels of the Colorado mine from a depth of 1800 ft., and the work, including about 600 ft. of cross-cutting, was completed in a little more than five months, at a cost of about $71,000.

Is this shaft brick-lined?

When considering the ventilation, the proposal was made to construct a circular concrete-lined shaft, so as to give the least area of resistance to the air, relative to the area of the cross-section. This, however, was considered impracticable, from the standpoint of time and expense. A substitute was devised, however, and an octagonal cross-section was adopted, with timber bricking constituting the sides of the octagon.

What do you mean by "timber bricking"?

The lining was constructed of blocks of wood approximately 8 in. wide by 10 in. deep by 3 ft. long, with a specially devised framing to fit the ends together in a proper manner to support the pressure, giving a smooth-lined, timber-cribbed, or bricked shaft, free from posts or lagging.

What is the diameter of the shaft?

The minimum inside diameter of the octagon is 6½ ft. This has an area of 34½ sq. ft., and gives approximately the same air-capacity as a smooth-lined two-compartment shaft with an area of 45 sq. ft. in the clear. The amount of timber, however, that would have been required for the two-compartment rectangular shaft would have been 72% greater, and the amount of excavation 50% greater than with the octagonal shaft. The cost of timber used in the main section of the shaft, at a price of $37 per M, including all temporary timber and the cost of framing, amounted to only $11 per foot, which is less than the cost of timber for the regular 5-ft. sets in a standard two-compartment shaft, using 12 by 12-in. wall-plates and end-plates.

How much less?

About 80 cents per foot of shaft.

Would you tell me something about your sorting-plant?

There is nothing very unusual about that. The skips of ore are hoisted and dumped into a small hopper, feeding directly into a mechanical grizzley of the Sheridan type, which is constructed of bars, the alternate members of which are operated by two sets of eccentrics, one set of bars raising the coarse ore, carrying it forward and depositing it on the other set of bars, which in turn repeats the performance, the fine passing through and the oversize being fed at a fairly uniform rate to a slow-moving belt-conveyor, with a speed of 30 ft. per minute, which acts in the double capacity of a distributing conveyor to the bins and a sorting-belt, from which the waste is removed by hand and the remainder of the ore separated into 'high-grade' and 'low-grade'. The ore as it is hoisted is classed as first-class or second-class and the fine of the one separated from that of the other by a swinging door placed beneath the grizzley. It has been found that the ore can be sorted at the rate of two skips, each containing 3½ tons, every five minutes, at a low cost and with good efficiency.

What is the low cost? That is, from mine to shipping-bin?

The cost per ton of ore hoisted is a little less than 8 cents, there being about 10% of waste removed, the remainder usually being divided into nearly equal quantities of first-class and second-class.

You have seen a good deal of improvement in safety precautions in the mines of Butte, and I presume that you have been glad to further this improvement?

Yes. At the Butte & Superior property our organization developed some protective features that were unique. One of these was the system of signaling to employees underground in the event of fires or dangerous gases,

by means of the introduction to the compressed-air lines of volatile substances such as valerianic acid, which would permeate the air in the underground workings with significant odors. I believe this was the first development of this practice. The idea originally suggested itself to me that the arteries of air-lines throughout the mines should be an almost ideal means of distributing signals, and we endeavored at first to develop some electrical warning, without, however, arriving at any satisfactory solution. I think it was my suggestion thereafter that an odor in the form of gas be introduced into the air, and the research department, under the direction of Arthur Hackwood, working on this idea, suggested the better plan of using essential oils or liquids, and discovered the good qualifications of valerianic acid. This is fed into the air-receiver on the surface with a gravity-feed lubricator.

Has the U. S. Bureau of Mines availed itself of this interesting information?

I understand that they have made some experiments and developed other suitable reagents. Another interesting development in connection with safety measures was the introduction of stations or chambers underground. At a small expense, short lengths of old crosscuts or drifts were partitioned off, with a door in the partition, and compressed-air lines carried into such stations, and, when available, water-lines, so that men finding themselves about to be cut off by dangerous gases may take refuge in the stations and prevent the entry of such gases by closing the door, this being made airtight by calking with oakum, which is kept in the station. The exclusion of gases is further ensured by opening a valve in the compressed-air line, which furnishes the miners with fresh air and forces air from the station into the adjoining workings. When water-lines are not available, barrels of water are usually kept on a truck at the entrance to the stations. Such stations are marked with a sign or red light and are well known to all the employees.

Those are both interesting safety measures. Have you any others?

There were many others adopted. It was a rule of the organization that all shift-bosses must have taken training in the use of air-helmets and in first-aid. Water-pressure lines were installed down the shaft and in stations, and many other provisions made for the safety of men underground. The two first mentioned, however, are the only ones that are worthy of mention.

Do you consider mining today still affords a good career for young men?

Yes, I think that as the mining industry finds more difficult conditions to cope with, as it necessarily must, the demand for engineering ability will become greater and the status of the mining engineer will continue to improve.

During your management of the Butte & Superior you must have had an opportunity, partly owing to the two big litigations, of becoming acquainted with a large number of professional men of high standing?

It was my pleasure to become acquainted with, as witnesses and counsel during these two lawsuits, many of the prominent and capable professional men of the day. Among the mining engineers there were J. W. Finch, D. W. Brunton, Albert Burch, Walter H. Wiley, W. L. Creden, D. C. Bard, Sam Barker, Carl Hand, W. H. Emmons, R. D. Salisbury, witnesses for the Butte & Superior, and H. V. Winchell, Professor Kemp, Fred Searls, Professor Irving, Rush White, the late Fred Green, Professor Leith, witnesses for the Clark interests. It has always been a source of gratification to me to feel that my organizations both at the Butte & Superior and the Davis-Daly were constituted of as capable, as loyal, and as energetic a personnel as can be desired. I am under obligation to almost every one of them for the support and assistance given me. Especially do I appreciate the helpful assistance and friendship of Charles Bocking as assistant manager, who succeeded me as manager; Angus B. McLeod, the mine superintendent (both of whom occupied these positions during my entire term); and of F. T. Wicks, J. T. Shimmin, and E. V. Daveler, successive mill superintendents, as well as many others that I would like to mention by name were the list not so long. Among those now in the Davis-Daly organization are several who served with credit at the Butte & Superior, including J. W. Dudgeon, chief engineer and geologist; B. F. Evans, efficiency engineer; L. S. Farnham, mechanical engineer; and S. A. Worcester, mechanical foreman. These men, together with Dan McGrath, mine superintendent; Clint Hansen, geologist; R. H. Barclay, construction foreman; J. E. Murphy, auditor; and B. A. Tower, mine engineer, have earned much credit in the conduct of Davis-Daly affairs.

Have you any ideas in regard to the education of young men for a mining career?

I think the tendency of mining school of the day is to emphasize too greatly the value of experience gained in practical ways, in mining and metallurgy, during school years, and that more attention should be given to a thorough understanding of basic principles. A fair amount of contact with actual operations is desirable, chiefly for the reason that it stimulates keener interest; but the amount of experience that can be obtained during these years is so small, compared with what must be later undergone, that it is of little consequence if it means a sacrifice, as it frequently does, of a proper training in the fundamental subjects.

Zinc dust has been marketed by domestic smelters since 1910, states a U. S. Geological Survey bulletin. The United States Zinc Co., at Pueblo, Colorado, was the first to prepare it for the market; the Grasselli Chemical Co. followed later; and one by one other companies began to save zinc dust, until in 1918 eleven companies reported production, a part of which was made by subjecting a stream of molten zinc to a blast of air.

Valuation of Placer Deposits

By Gerald H. Hutton

The exploitation of placer ground by means of dredge-mining has become an important industry. Rapid progress has been made in the development of a highly efficient machine for excavating the ground and recovering the precious metals; so remarkable has been the progress in mechanical improvements that it is possible, under favorable conditions, to dredge placer ground for 5½c. per cubic yard in spite of high prices for supplies, power, and labor.

Improvements in methods of sampling and valuing dredging ground, however, have not kept pace with mechanical developments. Standard methods of testing today produce only rough approximations of the value of the ground, although they obtain information concerning the character of the deposit and the bedrock. It is interesting to note that few important changes in the methods of ten years ago are to be recorded; on the contrary, the latest comparisons between sampling estimates and actual recoveries have varied so widely as to confuse the operator, and, in a degree, to shake the confidence of the capitalist. On this account, and because the growing scarcity of dredging ground demands closer and more accurate calculation, I desire to urge mining engineers and dredge operators to assist in formulating systems and methods that will tend to produce reliable results in testing placer deposits. Where an area has already been mined after having been sampled, a comparison of the results is invaluable for this purpose.

Some of the features which appear to warrant investigation, and which perhaps will encourage general interest and action, will be described briefly; and in addition, there will be submitted, among other data, a method for placing drill-holes and computing cubic-yard value by graphic formulae. These systems were evolved from a study of comparisons between the results of drilling and actual dredging of ground under the control of the Metals Exploration Co. While they may not be accepted as conclusive or of general application, they may be of service in directing effort toward the improvement of present methods of sampling and perhaps may be tentatively considered as a basis for the establishment of general principles for drilling.

THE GOLD CANYON DREDGE NEAR VIRGINIA CITY, NEVADA

Discrepancies Between Sampling Estimates and Actual Recoveries. As an example of these discrepancies: 15 cu. yd. has been mined to yield 4c. per cubic yard from the range or scope of a drill-hole showing 45c. per yard. In another instance, 100,000 cu. yd. dredged showed a recovery of 5½c. per cubic yard, from the scope of one 12c. and one 21c. drill-hole. Again, 5,600,000 cu. yd. dredged 10.4c. per cubic yard, whereas 16.5c. was indicated by the drill-holes. On the other hand there are instances where the unit recovery has exceeded the estimated content by similar margins. In all these examples, there has been no reason to suspect 'outside salting' of samples or unusual inaccuracies of weighing or measurement, for standard drilling practice was followed.

Deriving the 'Prospect-Factor'. It is unnecessary

to describe present-day methods of sampling or apparatus for drilling. Suffice it to state that work performed by the Keystone drill with a 6-in. drive-pipe is here accepted as standard. Shaft-sinking cannot be efficiently conducted in wet ground. The purpose of drilling placer ground is to obtain systematically an accurate representative sample, which is utilized to derive a general average. It is important, therefore, that the sample be of sufficient volume to be representative and at the same time that it be taken with sufficient care to be accurate. Unfortunately, each deposit has its own characteristics, which means that more or fewer samples will be required to obtain a true representation. It will be evident then, that each deposit has its individual 'prospect-factor', which, in general terms, is the ratio of the volume of the drill-cores, or number of drill-openings that will afford a consistent representation to the number of cubic yards sampled. To derive the 'prospect-factor' of a piece of ground it is suggested as a general plan that drill-holes widely spaced be systematically spread over the area and the average value per cubic yard derived therefrom. These wide intervals may then be bisected with additional holes and the average value per cubic yard determined from the total number of tests. At the same time, the result of each separate group of holes may be carefully checked and compared. This method may progress until the determinations in the latest stages approximately agree; or, until it has been proved that the addition of drill-openings, systematically spaced, causes no important variation in the determinations. The intention obviously is to increase, by systematic work, the probability of realizing the pre-determined recovery. Factors that will influence the continuation of this system of work will be, of course, the amount of money available for development, and the margin between determined recoverable gold content and the estimated cost of operation, since the desideratum of systematic sampling is primarily to justify investment. Modifications to the system should be made as required by special conditions; in this connection the gological history and conditions of the deposit will have important bearing.

METHODS OF MEASUREMENT USED. As stated above, in addition to the necessity for drilling ground sufficiently, it is equally important that the drilling be performed carefully and thoroughly so that data obtained may form a reliable basis for calculation. The personal element is of prime importance in drilling, particularly the experience and judgment of the engineer, driller, and panner; the work should proceed as far as possible with technical exactness. Measurements should be taken at every stage of the work and the logs designed in such a manner as to convey the most detailed information for the guidance of the engineer.

A method in common use is to measure the height of the core in the pipe before and after driving and pumping, and to measure the tailing from the rocker*; from these figures the engineer makes his adjustments and corrections. By one formula, 100 ft. of 6-in. drive-pipe is considered to represent one cubic yard of virgin

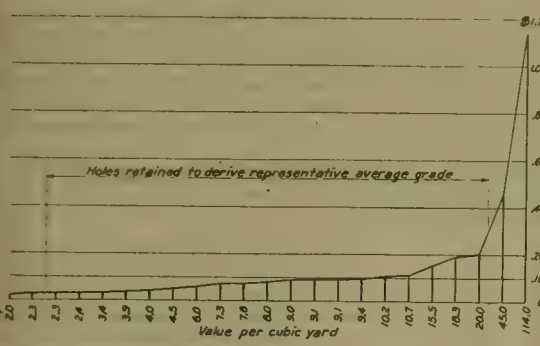
DRILL-HOLE REPORT

Depth ft.	in.	Number of colors 1	2	Corrected	Formation	Core-ratio Original	Corrected	General data:
2–	0	...	...	...	L. C. G.	0.33	....	Date begun 9/28/20 at 7 a.m.
3–	0	...	1	1	"	0.41	0.65	Date finished 10/1/20 at 12 m.
4–	0	...	...	...	M. C. G.	0.45	....	Pulling pipe 5 hr. Moving 2 hr.
5–	0	...	...	...	"	0.41	....	Drilling 22 hr. Repairs
6–	0	...	...	...	C. G., Md. T.	0.63	....	Total time on hole 29 hr.
6–	11	...	...	...	" " hard drilling	0.58	....	Drill used Keystone No. 3
8–	0	...	...	...	" "	0.63	....	Size of pipe 6"
9–	0	...	...	...	Md. C. G., R. T.	0.49	....	
10–	0	...	...	...	" "	0.33	....	
10–	6	...	...	...	C. G., H.	0.29	....	
11–	0	...	...	...	V. H. boulder	0.41	....	Elevation data:
11–	6	...	..	...	C. G. H.	0.29	....	Surface elevation 1425.32
12–	0	...	...	...	"	0.17	....	Depth to water-level 19'–0"
12–	6	...	...	...	"	0.21	....	Depth to bedrock 22'–6"
14–	0	1	1	22	Md. C. T. G.	0.45	0.49	Total depth 24'–0"
15–	0	...	2	4	R. F. G., Md. L.	0.33	0.53	
16–	0	...	1	2	" "	0.29	0.47	
17–	0	...	...	...	F. G., Sm. yellow Cl.	0.29	....	
17–	9	...	...	...	Md. F. G.	0.37	....	Valuation data:
18–	7	...	...	...	" R. T.	0.49	....	Gold per oz. $19.00 Fineness 920
19–	0	...	1	1	" "	0.33	1.27	Gold per mg. 0.06
19–	6	...	1	1	" "	0.37	1.17	Wt of sample 482 mg. Value $28.92
19–	10	...	3	1	Md. C. G., T.	0.45	2.16	Correction 81
20–	7	1	10	16	" M. S., Ranin T.	0.58	1.23	Corrected wt. 401 mg. Value $26.8
21–	5	5	125	170	" " "	0.53	1.024	Volume of sample 6.345 cu. ft.
22–	0	2	100	88	" " "	0.49	1.35	Volume of sample 0.235 cu yd.
22–	6	2	25	43	F. G., T., V. clayey	0.33	1.05	
23–	0	1	10	22	Soft B. R., M. Cl., Sm. S.	0.29	0.91	Value per cu. yd $1.14
23–	6	...	1	1	Ground B. R.	0.37	1.17	Remarks: Core-ratio was increased to 160% as
23–	6	...	...	...	" "	0.49	....	follows:
		...	401	372		12.08	13.474	For slimes 28% of tailings For inaccurate bucket measure 25%

*An improved design of the old placer miner's device.

ground, and the value per cubic yard is thus simply obtained. Other methods involve the use of various arbitrary constants, based on the relation of pipe-content or core to 'bank-measure', a term applying to the volume of unmined ground.

An elaboration on these methods is suggested. The coarser material from each foot of 'drop' [or hole] may be measured in a box or calibrated bucket, and a record made of the ratio between the actual core extracted and the theoretical volume of core from this foot of drop. The slime or material in suspension in the water may be allowed to settle in a special box or pit for measurement. If the precious metals are obtained from a stratum whose 'core-ratio' varies from the average of those of the total number of holes drilled, then the results are subject to



GRAPHIC CHART OF 23 DRILL-HOLES SHOWING METHOD OF ELIMINATION

correction in proportion to that variation. Before using the core-ratio in the final computations, however, it is essential that the core-ratios be increased by allowance for the slime, by an amount depending on the ratio of slime to measured tailing. This follows for the reason that the slime has not been included in the material that has established the core-ratio. The core-ratios of each foot of drop of each hole also should be added; and if the determination of total volume is less than the amount of the measured tailing, the core-ratio may be increased in proportion to the deficiency, since the bulk measurement of the tailings clearly will be more reliable than the repeated gradual measurements of the core.

It may be of interest to present a specimen report of a drill-hole showing a correction of the estimates in the manner described. (See opposite page.)

Method of Correcting Determinations

Tailing, cu. ft.	4.06
Slime, cu. ft.	1.125
Total, cu. ft.	5.185

Slime = 28% of tailing

Add core-ratios, 12.08

They should be 23.50 which is 51%

Theoretical volume of sample $= \frac{23.50}{100} \times \frac{27}{1} = 6.345$

51% of 6.345 = 3.235

This indicates that the tailing measured in the boxes (4.06) is 0.825 cu. ft. in excess of the measurement by each foot of drive.

It is impossible to account for this descrepancy except by inaccurate measurements; both measurements are of the same material, and there is no reason why the material should be greater in volume after it leaves the rocker than before. It should be reasonable therefore to add the amount of this discrepancy to each core-ratio.

Volume by tailing = 4.06
Volume by core-ratios = 3.235
Difference = 0.825 = 25%

Depth feet and inches	Core-ratio	Add for 12-in.	Add for inaccurate measurement 25%	Add for slime 28%	Colors Found	Colors Corrected
2– 0— 3– 0	0.41	0.41	0.51	0.65	1	1
12– 6—14– 0	0.45	0.30	0.38	0.49	11	22
14– 0—15– 0	0.33	0.33	0.41	0.53	2	4
15– 0—16– 0	0.29	0.29	0.37	0.47	1	2
18– 7—19– 0	0.33	0.79	0.99	1.27	1	1
19– 0—19– 6	0.37	0.74	0.92	1.17	1	1
19– 6—19–10	0.45	1.35	1.69	2.16	3	1
19–10—20– 7	0.58	0.77	0.96	1.23	20	16
20– 7—21– 5	0.53	0.64	0.80	1.024	175	170
21– 5—22– 0	0.49	0.84	1.05	1.35	120	88
22– 0—22– 6	0.33	0.66	0.82	1.05	45	43
22– 6—23– 0	0.29	0.58	0.72	0.91	20	22
23– 0—23– 6	0.37	0.74	0.92	1.17	1	1
				13.474	401	372

Value of sample = 482 mg. @ $0.06 = $28.92
Corrected value = $28.92 × 372 ÷ 401 = $26.80

Corrected value per cubic yard $\frac{\$26.80}{23.50}$ = $1.14

By using this system of measurement, such conditions as compression or displacement of cores and the liability of automatic 'salting' by the intrusion of precious metals may be generally detected; but it is recommended that the engineer be conservative in increasing his stratum-recovery for low core-ratios, because: (*a*) The recovery may be obtained from only a portion of the amount of drop, which portion may have a standard core-ratio. Theoretically, then, it would be more reliable if core-ratios were established at every inch of drop. (*b*) The general tendency in drilling would seem to be for the gold to intrude into the pipe rather than to be excluded, on account of such factors as the pressure of the ground on the pipe, the inflow of seepage water, or the pumping action of the bit in churning.

In general, the engineer should endeavor to remove as many variables as possible; he should familiarize himself with such influences as the swell of the ground, the presence of clay, the effect of tight or loose strata, the distortion of the drill-shoe by driving, and natural irregularities such as boulders and excessive amounts of sand.

VARIATION IN GOLD. Variation in the size of the particles and the character of the gold or platinum should be carefully noted in the logs. Distinctive, coated, float, and flour gold, which are difficult to save in actual operation, should be weighed separately and so recorded, in order to guide the engineer in his final recovery-factor. Fineness of the gold should be carefully checked. It will be of advantage to weigh samples at every 5 ft. of depth below an established depth, to guide the operator as to his most profitable digging-depth. At the same time, the estimates per cubic yard should be discounted because of the necessity in operation of cleaning bed-

rock; ample provision for this increased depth should be made in the calculations. The physical condition of the deposit should be given careful consideration, and expected recoveries should be reduced to provide for any impoverishment of the bank by reason of tailings, voids, unprofitable blocks, or other exigencies. In shallow deposits, allowance for digging into bedrock to obtain the necessary depth for safely floating the dredge reacts to cause a serious reduction in the estimates per cubic yard. Furthermore, there is the personal element of the operating crew to be taken into consideration; and allowance should be made for the efficiency of their work.

Drill-Holes of Extremely High or Low Grade. It is generally expected in dredging that the ground in the immediate scope or range of drill-tests that are extremely high in value will give lower recovery; and inversely that the scope of drill-tests that are extremely low will give higher recovery than that indicated by sampling. The rule of averages, however, does not attach major importance to the localization of the precious metals, because each accepted drill-determination is utilized as a unit in the group from which is derived the average. From this reasoning, it would appear that holes of extremely high grade have relatively small scope. Some interesting calculations may be made from the figures of old records, if the drilling has been accurately done, to prove the number of cubic yards affected by any drill-hole of extremely high or low value. Two rules of finding averages are commonly utilized in drilling calculations: one is to divide the sum of all the particular quantities of the same sort by the number of them; or, in this case, to divide the sum of the products of the depths multiplied by the corresponding value per cubic yard, by the sum of the depths of all the holes. The alternative is to accept the mean between extremes by the process known as cancellation. No practical advantage has yet been discovered for calculating the number of cubic yards affected by holes of extremely high or low value, although there are possibilities in this direction. A combination of the two rules of average as described appears to be logical, inasmuch as the extreme values are assumed to have been actually found and therefore should have an influence on the general result, although their scope may be relatively small. Therefore it is suggested that, in any future comparisons of predictions and results, extremely high drill-holes be cancelled with the same number that are extremely low and the content of the ground be derived from the number of tests of average or mean value remaining. The extremes may be tentatively determined by means of a curve plotted in graphic form in order of value of the various holes.

To illustrate the method of computing the unit value by graphic formula, it is assumed that 23 holes spaced at regular intervals have been drilled to give accurate representative samples of a given piece of ground. The chart of these holes, shown herewith, warrants the cancellation of the $1.14 with the 2c. hole, and the 45c. with the 2.3c. hole, leaving the value per cubic yard to be determined from the average of the 19 remaining holes, by simply multiplying the depth by the value. Assuming the depths of all the holes to be equal, the value per cubic yard is 8.46c. If the average scope of each hole is 20,000 cu. yd., then, to be consistent with the average determination of 8.46c. per cubic yard, there would be theoretically 18,846 cu. yd. @ 2c. per cubic yard and 1154 cu. yd. @ $1.14 per cubic yard within the scope of the $1.14 hole. It is apparent, therefore, that if the gold sustaining the estimate of $1.14 per cubic yard has actually been found, it represents only a small quantity of ground; the grade being extremely high, the volume of ground affected is extremely small. The calculation to determine the influence of extremes in value in a given area is as follows:

Effect of Cancelling Hole of Extremely High Value with Hole of Extremely Low Value

Let a = number of cubic yards affected by hole of extremely high value, $1.14 per cubic yard.
b = number of cubic yards affected by hole of extremely low value, 2c. per cubic yard.
20,000 = number of cubic yards affected by each of the 23 holes as shown on the diagram.
8.46c. = value per cubic yard as determined by the diagram.

Then each hole will theoretically represent 20,000 cu. yd. with a precious-metal content of $1692.

$$a + b = 20{,}000 \text{ cu. yd.}$$
$$(a \times 114) + (b \times 2) = 169{,}200$$
$$a = 20{,}000 - b$$
$$b = 20{,}000 - a$$
$$(20{,}000 - b) \times 114 + 2b = 169{,}200$$
$$2{,}280{,}000 - 114b + 2b = 169{,}200$$
$$112b = 2{,}110{,}800$$
$$b = 18{,}846.4 \text{ yd.}$$
$$a = 1{,}153.6 \text{ yd.}$$

Therefore, theoretically, in the scope of the $1.14 drill-hole, 20,000 cu. yd., there are 18,846 cu. yd. of 2c. per cubic yard material and only 1154 cu. yd. of $1.14 material.

This article aims, in a general way, to form a basis for systematic investigation and technical discussion of a problem of vital importance to the mining industry. Objections may be raised that the ground is too greatly disturbed by pipe-driving and drill-churning; that the distribution of the precious metal prevents representative sampling; that tight ground drills differently from loose; that natural conditions are against scientific or technical methods, and so forth. Perhaps investigation will demonstrate the advantage of an 8-in. or 10-in. drive-pipe instead of 6-in.; it may prove that drilling is not the correct method of sampling and valuing placer ground, or that it is economically impossible to evaluate accurately. On the other hand, intelligent working principles of general application may be evolved that will be of lasting value to the mining industry.

The amount of manganese ore containing 35% or more of manganese in sight in the deposits of the United States has been estimated by the U. S. Geological Survey at about 700,000, with 1,130,000 tons more in prospect. In addition, more than 17,000,000 tons of low-grade ore, containing from 5 to 35% of manganese, is estimated to be in sight in the known deposits.

Book Reviews

The People of Mexico. By Wallace Thompson. 427 pp. Published by Harper & Brothers, New York. For sale by the 'Mining and Scientific Press'. Price, $2.50 net.

The sub-title says, 'Who They Are and How They Live', and that is what the author tells his readers. It is information that will be welcomed by many, including those who have been to Mexico; for a single journey to a country so diversified as Mexico will not suffice to give the traveler an intimate knowledge of the ways of its people; and even those who have resided there for a few years, at the mines, for example, may have found neither the time nor the opportunity to learn much about other parts of a country so large as Mexico. In his preface Mr. Thompson says that his book "offers itself as an anatomy of Mexico". It deals with a sick nation and it undertakes to diagnose her disease. The cause, he says, is racial; and this is the conclusion that he elaborates on the basis of the statistical, ethnological, and political data with which the book is enriched. Much of the information comes from the files of the Doheny Research Foundation, to which other recent writings on Mexico are traceable.

The first question he asks is, "What is a Mexican?" The answer is told statistically thus: "The 15,000,000 Mexicans include 6,000,000 pure-blooded Indians of fifty tribal strains, and until the exile of the upper classes under Carranza approximately 1,000,000 pure whites of Spanish lineage also called themselves Mexicans; between the two extremes are 8,000,000 mestizos (literally 'mixed bloods') to whose creation the two primary races have for four centuries contributed contrasting elements. It is the resultant hybrid whose numbers make him the typical Mexican of today." The author describes the physical qualities of these constituent races and asserts that "intellectually and psychologically the Mexican mestizo is more of a hybrid than he is physically. His body type has varied characteristics, although perhaps tending disproportionately to the Indian, but in his brain there seethes the continual conflict of intellectual and psychological predispositions which go back to cultures which in the history of humanity are thousands of years apart". Later he adds: "The Mexican is the victim of his mixed racial and cultural heritage, the plaything of primal forces which tend ever to neutralize one another in a personality often unworthy alike of his rich Spanish intensity and of his Indian simplicity". Under Spansh rule Mexico flourished, says the author, as it did under Diaz, who recalled the white aristocrats from exile and used them in the national service. With Diaz went the Spanish tradition. "What we have seen for the past ten years may be called the disintegration of the mestizo idea of nationalism into its component parts. What the Mexican calls 'personalism' in politics is but the remnant in the mixed stock of the self-assured superiority of the whites, and the anti-foreign laws and the bloody outrages upon the whites are but the Indian fear and hatred of white domination." That is the text of the book; this is the interpretation of Mexico that Mr. Thompson offers. The events that have brought Mexico into unpleasant prominence during recent years are attributable, he says, to "the uprising of the dark races against the white, a movement too mighty in its scope and too patent a peril to be glossed over by anyone who would speak truthfully of conditions in Mexico today". He quotes Esquivel Obregon, a publicist who ought to understand his own people, to the same effect: "At the bottom of all the troubles of Mexico is the prehistoric Indian civilization trying to destroy the European civilization".

The early Spaniards (1520) aimed at racial amalgamation, at inter-breeding, the result being a mixed race that in the end (1810) threw off the Spanish yoke. After 1823 the new race of mestizos set itself up as the inheritor of Spanish superiority. But the Indian blood asserted itself above the white, so that today the predominating factor is Indian. "A hundred years ago his [the Mexican's] Indian blood raised him against white rule; and today his Indian blood has almost conquered his white virtues." In short, "unless the white world again take up the burden, Mexico must inevitably slip back to the plane of pre-Spanish barbarism". Mr. Thompson has in mind something like Santo Domingo, it may be presumed, and he seems to suggest that the United States should interfere in Mexico as in Santo Domingo. If he does, he preaches a crusade for which I have no liking or sympathy, because I believe it would be a colossal blunder and deeply injurious to the welfare of the American people, whatever its consequences to Mexico. This is a feature of the book that I find repugnant, for the reason that it suggests the sinister propaganda of the oil-operators. On the other hand, Mr. Thompson gives much interesting and generally reliable information, for which alone the book is valuable, especially to the mining profession.

The vicissitudes of the white population are told by statistics. In 1810, at the time of the first revolution, there were 60,000 foreign-born in Mexico; in 1825, after the expulsion of the Spaniards, the number was not over 1000; in 1895 there were 3713; in 1900, 57,508; in 1910, 115,869. This growth coincided with the regime of Diaz, who welcomed foreign participation in exploiting the natural resources of the country. In 1920, after successive revolutions, only 5000 foreigners were residing in Mexico. Fully 87% of the population claim Spanish as their native tongue, but, as Madison Grant has said, "the language that a man speaks may be nothing more than evidence that at some time in the past his race has been in contact, whether as conqueror or as conquered, with the original possessors of such language".

"The white race", says the author, "has given to Mexico its language and its predominant culture. Racially, its chief contribution has been its part in the formation of the half-caste mestizo, and in the maintenance of that remnant of white aristocracy which, from time to time, has saved Mexico from utter self-destruction." According to this interpretation, the Indian blood of Diaz and of Huerta, for example, was in conflict with their white strain, and such cruelties as they perpetrated would be imputed, by Mr. Thompson, to the indigenous taint. One would presume from this that the Indian is incapable of being civilized or of assimilating the culture of the white people, including their humane qualities, as if the whites had never produced pirates and had never indulged in blood-thirsty atrocities. The memories of the Great War are too recent to permit any such self-complacent generalization. Mr. Thompson hammers his thesis again: "At times throughout Mexican history, hatred of the white man for his self-assumed superiority as much as for his oppression, has sprung into flame. Such a period is that in which Mexico is living today. The anti-foreignism expressed in the harangues of the leaders and in the Constitution of 1917 is basically Indian and basically anti-white. The Zapata phase of the revolutions of the last ten years was frankly and completely Indian, Zapata's object being, as he stated, to drive out the whites and mestizos and possess the rich state of Morelos for the Indians who were its indigenous inhabitants". Mr. Thompson uses the simile of the melting-pot, and insists that the fusion of races is incomplete, "each element tending rather to agglomerate with its own kind than to the creation of a fused alloy". Well, we are hardly in a position to brag concerning our own melting-pot, in which unfused lumps are only too discernible. We would like to see one of our learned Mexican friends reply to Mr. Thompson, for example, Señor Ezekiel Ordoñez. We can imagine the task would be easy and agreeable.

Reverting to the statistics. Here are more:

Year	Percentages White	Mestizo	Indian	Approximate numbers White	Mestizo	Indian
1519	..	..	100	.....	.....	6,000,000
1810	18	22	60	1,080,000	1,320,000	3,600,000
1905	15	50	35	2,100,000	7,000,000	4,900,000
1910	8	52	40	1,150,000	8,000,000	6,000,000

The climate is a decisive factor in racial development. "Not only is the pure white unfit for manual labor, but the mixed blood, almost in direct ratio to the predominance of the white strain, is physically weaker and physically less resistant to climatic conditions than his more Indian brother." That is why the Indian is first in "selective animal force". As the author says, "With his short generations and his adaptability to the Mexican climate, the Indian contribution to the mestizo is overwhelmingly one of vital force". He demurs to putting the mestizo first in "sociological importance", as is done in an official paper. "The culture and institutions of Mexico", he says, "are white—or they are Indian; the mestizo has nothing of his own to contribute, and either emphasizes the white as he did under Porfirio Diaz or rides in a wild orgy of Indianism as he is doing today." The preface is dated November 1, 1920. For the mestizo the author has contempt only; for the Indian he has a bitter dislike. This will not be shared by most mining engineers familiar with Mexico; they have found the Indian more trustworthy than the mestizo, although less smart. However, he recognizes that the breaking down of the color line is complete in Mexico and it has given the Mexicans a homogeneity unlike those of the peoples south of them, or, he might have added, north of them. What Mexico needs at this juncture is a leader and a master, we are told: "An aristocracy of those who understand and live and serve as well; an aristocracy fed deep with ideas, giving them out, growing with them and with its people; an aristocracy with institutions, a great, free institution of honest, devoted government, institutions of learning where true leaders, ever renewing themselves, may be brought up, schools where hand and heart shall be trained together, where peon and aristocrat may meet, and understand each other, always". That is excellent, but Mexico is not the only country that needs such an aristocracy; the Rio Grande does not separate us from a similar ideal. Mr. Thompson finds such an aristocracy in "the Great Mexicans who alone must take up their country's regeneration" and are waiting "silent and uncomplaining . . . for the support which can come only from those in whose hands rests the scepter of the white man's world". In short, the exiled Spaniards and mestizos await American support for re-establishing their domination in Mexico. That is the message of this book. For those who advocate intervention, it will provide arguments; to all interested in Mexico it will give timely information, and warning.—T. A. R.

Elements of Fuel Oil and Steam Engineering. By Robert Sibley and C. H. Delaney. Second edition, revised, enlarged, and re-set. 466 pp., 6 by 9, ill. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $5.

This is the second edition of the well-known treatise that met with such a favorable reception when published first in 1918. The leading author is the talented editor of the 'Journal of Electricity and Western Industry' and was formerly professor of mechanical engineering at the University of California. The book has as its underlying theme a study of fuel-oil power-plant operation, and the efficiency of oil-fired plants. The subject matter has been treated in three main subdivisions: on exposition of the elementary laws of steam engineering; the process involved in the utilization of fuel-oil in the modern power-plant; and the testing of oil-fired boilers. The elementary laws of steam engineering are set forth in a new manner, in that the viewpoint is taken of the oil- and not the coal-fired plant. The results are given of a considerable amount of labor and analysis in connection with burner, furnace, and fuel-oil tests. Definite suggestions are made for carrying out fuel-oil tests. Many illustrative problems on steam-engine and boiler economy are given. The new edition is entirely re-written, and much new material has been added; many of the newer portions of the work have appeared in either the columns of the 'Electrical World' or in the 'Journal of Electricity'. The treatise has taken its place as a standard text-book on the subject.

Highway Engineering. By George R. Chatburn. John Wiley & Sons, Inc., New York. 379 pp., illus. For sale by 'Mining and Scientific Press'. Price, $3.

In this treatise the author, who is a lecturer on highway engineering at the University of Nebraska, has endeavored to bring into a brief space the most recent and best practice as determined by experience and research. The text is more commonly concerned with rural roads; these have been covered in greatest detail. Pavements have been considered with a view to their use for country roads, although the treatment may be regarded as sufficiently comprehensive to form a beginning or short course for those who are desirous of taking up city paving work. The book is intended primarily to form one of a series in agricultural education; it should, therefore, be read with interest by the layman, and will serve as a useful reference book for professional engineers, road builders, and road officers. The principal subjects dealt with include: I. The Economics of Road Building. II. Road Location. III. Types and Adaptations of Roads. IV. Drainage. V. Culverts and Bridges. VI. Earth Roads. VII. Sand-Clay Roads. VIII. Gravel Roads. IX. Broken-Stone Roads. X. Pavement Foundations. XI. Brick, Stone, Wood, and other Block Roads. XII. Concrete Roads. XIII. Bituminous Roads. XIV. Surface Treatment to Mitigate and Prevent Dust. XV. Revenue Administration and Organization. XVI. Miscellaneous.

Oil Land Development and Valuation. By R. P. McLaughlin. McGraw-Hill Book Co., Inc., New York. 200 pp., illus. For sale by 'Mining and Scientific Press'. Price, $3.

The author of this treatise, who was formerly the State Oil and Gas Supervisor of California, has produced an excellent volume in which an outline is given of the steps that are necessary for the full and proper development of lands that have been shown to be oil-bearing. A detailed study is made of the precautions that must be observed with regard to construction and maintenance of wells that tap the original source of supply, the information having been based on the author's long experience in making engineering and geological investigations of oilfields. The contents of the book are as follows: I. Development Program. II. Drilling of Wells. III. Assembling Information Relative to Underground Conditions. IV. Production of Oil. V. Repairing, Deepening, and Abandoning Wells. VI. The Value of Oil Land.

Dictionary of Chemical Terms. By James F. Couch. 204 pp. D. Van Nostrand Co., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

This is an excellent little book that has been compiled to cover a new field, and will be found to be of value and convenience to the chemical specialist as well as to the engineer or layman. It bears the impress of careful preparation and editing. The author, showing commendable breadth of view, invites the fullest constructive criticism from readers with reference to any errors that may be noticed. Such an attitude should ensure accuracy in subsequent editions, if a critical examination by specialists discloses any fault in the present one.

MINERALS SEPARATION V. BUTTE & SUPERIOR; HEARINGS ON ACCOUNTING

The instructions of Judge Bourquin to the master before whom the account for damage due Minerals Separation from the Butte & Superior Mining Co. for infringement of froth-flotation patents is peculiar in its wording, and, in the opinion of attorneys, is slightly doubtful in its interpretation. In his instructions Judge Bourquin says that the master, keeping in mind the distinction between processes and standards, shall be governed by the rule that the standard in this accounting shall be "any standard that may be duly made to appear in respect to subsequent infringement".

Earlier in his decision the Judge said that, while the points involved are rather new, the principle to be followed was the decision of the Supreme Court in several somewhat similar cases that "the fruits of the advantage which he (the infringer) derived from the use of the invention were those over what he would have had in using other means then open to the public and ad quate to enable him to obtain an equally beneficial result". This Judge Bourquin said clearly meant that "what the infringer thus gains is also what the patentee is presumed to lose, so far as accounting for profits is concerned and equity is done when all such gains are taken from the infringer and given to the patentee", adding, "it seems fairly clear that this is the import of the quoted language of the Supreme Court". Already the recorded testimony, briefs, arguments, and decisions in the several froth-flotation patent suits in the various courts of the United States exceed 15,000,000 words, and as yet no clear definition of the scope of these patents has been arrived at.

ANACONDA COPPER SPENDS $500,000 MONTHLY TO PRESERVE ITS MINES

It is costing the Anaconda Copper Mining Co. $500,000 per month to stay closed down. Production of ore was stopped in April, but it was not until toward the latter part of that month that all departments ceased functioning. Ore and concentrate on hand were cleaned up and it is probable the actual expenses of Anaconda in the first months of its shut-down were considerably in excess of this sum. This is an example of why mining men preferred to keep their properties open until the absolute stagnation in the industry demanded that production of copper cease. Anaconda today is employing approximately 2600 men. These are mostly care-takers, watchmen, and mechanics to supervise the machinery and keep it from deteriorating through idleness. While wages have been cut, they are still higher than prior to the war.

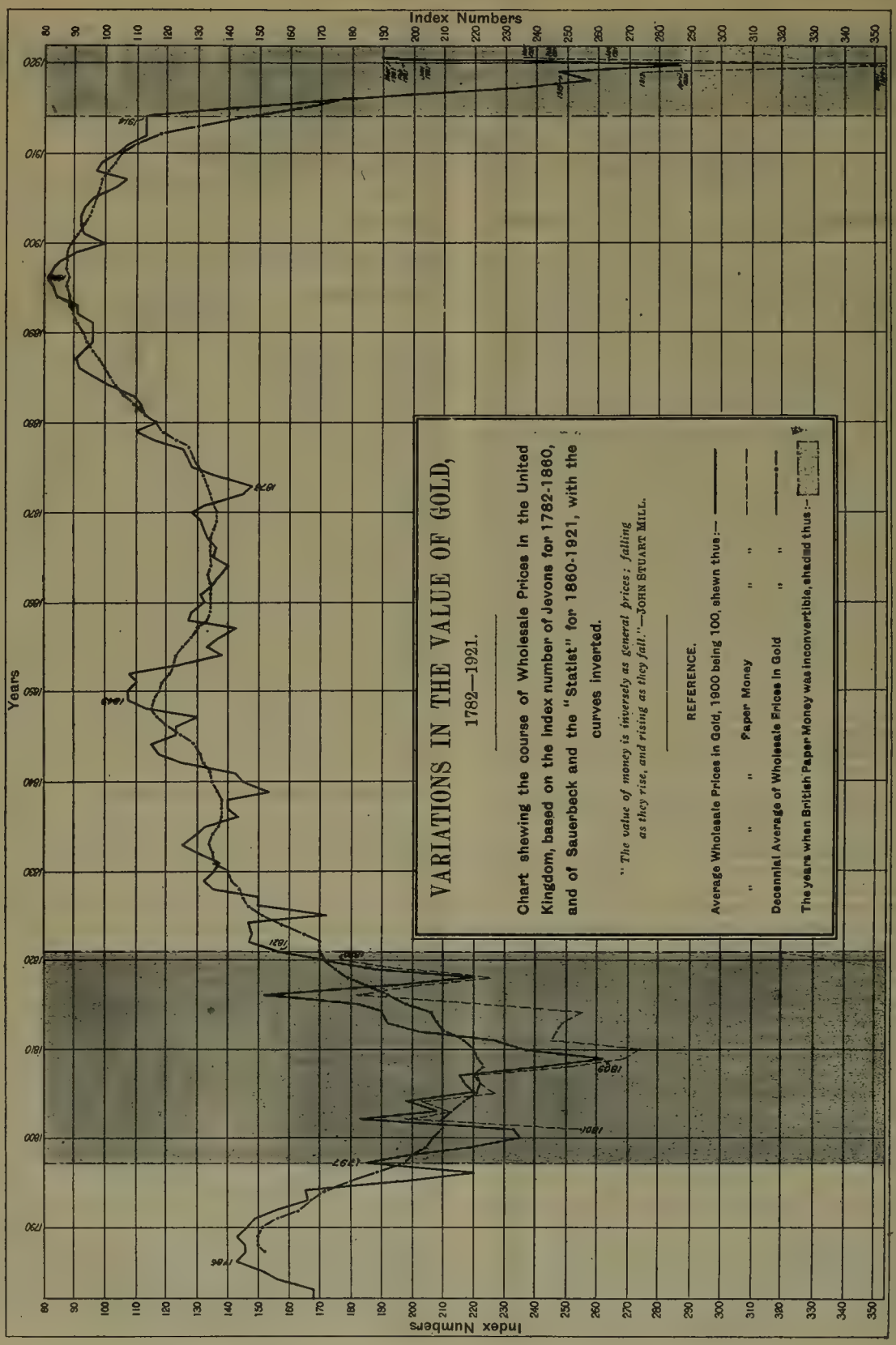
In addition to its shut-down expenses, Anaconda's bond interest is, of course, continuing. The company has outstanding $25,000,000 in 6% bonds and $25,000,000 in 7% bonds, both issues maturing in 1929. Here is an interest charge of $3,250,000 per year, which, with current expenses of $500,000 per month, means that it is costing the world's largest copper producer $10,000,000 per year to 'stay on earth'. Anaconda, however, has a wealth of fixed and liquid assets and can stand the strain. At the close of last year net current assets exceeded $67,860,000, of which cash and accounts receivable amounted to nearly $25,000,000 and metals amounted to $32,500,000. This latter account has undoubtedly been very much reduced by now. After providing for the bonds at par, Anaconda still has over $7 per share in 'net quick' for its 2,331,000 shares of stock.

PHELPS DODGE-ARIZONA COPPER DEAL LIKELY TO BE CONSUMMATED

It is believed certain that the Phelps Dodge Corporation will take over the property of the Arizona Copper Co., a British corporation. The deal is considered closed except for the compilation of the final audit and minor details of supplies on hand. Auditors from the New York office of Phelps Dodge are busy with the auditing of accounts. Current negotiations are on a basis of exchanging about $5,000,000 par of Phelps Dodge stock for Arizona Copper common stock. Although it has $50,000,000 authorized capital the Phelps Dodge Corporation never issued more than $45,000,000. Arizona Copper also has a preferred issue, to acquire which Phelps Dodge will make additional payments possibly in cash. In the event of the transfer, the Arizona & New Mexico railroad, which is over 100 miles long, from Clifton to Hachita, by way of Lordsburg, would become part of the El Paso & Southwestern system. The lighting and power service of the entire district has been transferred from the Arizona power-house, at the smelter below Clifton, to the Phelps Dodge power-house at Morenci, where the Diesel engines are more economical. It is reported that J. P. Hodgson, formerly manager for the Detroit Copper Co., at Morenci, is to take Norman Carmichael's place as general manager of the Arizona Copper plant.

PRESENT OPERATIONS OF GARFIELD SMELTER

A. H. Richards, general superintendent of the Garfield smelter, recently discussed the operations at that plant. He predicted that Utah will lead all other States in the output of silver this year. The Garfield smelter, by slight changes in its smelting processes, is now treating a large tonnage of silver silicious ores from the Part City and Tintic districts. As a result of improvements at the Garfield smelter, Mr. Richards stated that the plant is now the largest of its kind in the world. In 1918, the smelter produced an average of 643,643 lb. of copper per day, with a payroll of $209,890 per month; in 1920, it produced 340,422 lb. of copper per day, with a payroll of $99,152 per month, whereas during the first six months of 1921 it produced 221,212 lb. of copper per day, and the payroll was about $60,000 per month. At present, about 500 men are employed. Mr. Richards stated that the maximum capacity of the plant is 5000 tons per day, whereas at present an average of 1200 tons of ore is being treated per day. The present output of gold is 100 oz. daily and of silver about 10,000 oz. daily. The plant consumes 117 bbl. of fuel-oil and 223 tons of coal per day. Mr. Richards expressed the opinion that the Utah Copper Co., the largest shipper on the smelting company's list, would resume operations early in 1922. The smelting company recently shipped the last of the 17,000 tons of Utah Copper blister that has been stored in the smelter yards. This bullion was shipped by way of San Francisco and the Panama Canal to the Atlantic seaboard, which resulted in a saving of about $4.50 per ton, as compared with the all-rail route.


Index Numbers
Years
Index Numbers
VARIATIONS IN THE VALUE OF GOLD,
1782—1921.
Chart shewing the course of Wholesale Prices in the United Kingdom, based on the Index number of Jevons for 1782-1860, and of Sauerbeck and the "Statist" for 1860-1921, with the curves inverted.
"The value of money is inversely as general prices: falling as they rise, and rising as they fall."—JOHN STUART MILL.
REFERENCE.
Average Wholesale Prices in Gold, 1900 being 100, shewn thus:—
" " " Paper Money
Decennial Average of Wholesale Prices in Gold
The years when British Paper Money was inconvertible, shaded thus:-

PURCHASING POWER OF GOLD

Recently Mr. Samuel Evans, the chairman of the Crown Mines, Ltd., referred, at the annual meeting of shareholders, to the variations that have taken place in the wholesale prices of commodities in England since 1782, as reproduced in the chart on the opposite page. The data were obtained from the index figures prepared by Jevons for the years 1782 to 1860, and by Sauerbeck and 'The Statist' for the years 1860 to date. From this it will be seen that the purchasing power of gold fell between 1786 and 1809, it rose between 1809 and 1849, it fell between 1849 and 1873, it rose between 1873 and 1896, and it fell between 1896 and 1920. During the 139 years the value of gold was seriously depreciated on two occasions; and this was due, in both instances, to the excessive use of inconvertible paper money. The first period, during the operation of the Bank Restriction Act, which provided for the suspension of specie payments by the Bank of England, lasted from 1797 to 1821; it has been described as the dark age of currency in England. The second period commenced with the issue, under the Currency and Banking Notes Act of 1914, of £1 and 10-shilling legal-tender notes, commonly known as Bradburys; it will last, in the opinion of Mr. Evans, until Great Britain reverts to sound money, with a free market for gold. The free market exists nowhere today except in the United States.

ARIZONA

Kingman.—Plans are being made to develop at a depth of 700 ft. the orebody already opened to a depth of 400 ft. in the Katherine mine. The ore blocked on the first three levels totals 120,000 tons of an aggregate value of $1,563,472, according to one report. This ore is sufficient to warrant the erection of a 300-ton mill.

An east-west vein 26 ft. wide was recently opened in the Gold Chain mine. A drift is now being extended to the east in the original foot-wall vein at a depth of 100 ft. in the direction of the Comstock Consolidated, or Curtin-Mahoney property. Cross-cuts are to be driven through the vein at 100-ft. intervals. This work is to be followed by the sinking of the shaft to a depth of 200 ft., where a level will be established and cross-cutting done.

Tombstone.—The Old Guard mill is running regularly and is reported to be getting good extractions. The Mellgren mill is at present running the tailing dump at the old Fisher mill. The Bert Holland mill is temporarily closed but will be going shortly. Another tank and vacuum-pump will be installed to increase the water flow, and when the mill starts it is planned to maintain regular operations, as no doubt the water flow will be made satisfactory by the installation of the pump.

ARKANSAS

Zinc.—The Odum zinc mine, the last to cease operations in the north Arkansas field, has just closed down. There is not a mine in operation in the field; this is the first time that such a condition has existed in 20 years. The last concentrate sold by the Odum company brought $14 per ton, which was below the cost of production.

CALIFORNIA

Amador City.—The following gentlemen attended the monthly meeting of the Mother Lode mine superintendents, held at the Fremont mine on August 27: W. J. Loring, of San Francisco; G. A. Rose, of San Francisco; George Vrang, of San Francisco; S. E. Robbins, engineer at the Fremont mine; E. Higgins, consulting engineer; C. F. Burt, mining engineer at the Bunker Hill mine; A. D. Stevenot, superintendent of the Carson Hill mine at Melones; Stanley Arnot, superintendent of the Plymouth Consolidated mine at Plymouth; I. B. Hoxsie, superintendent of the Fremont mine; O. D. Rohlfs, superintendent for the Amador Gold Mining Co.; R. E. Christensen, superintendent of the Bunker Hill mine, and N. W. Hyler, president of the Bunker Hill mine.

Bishop.—The 75-ton mill of the Wilshire gold mine has been in operation since July 27. A concentrate averaging $200 per ton is made from ore averaging $7.50 per ton. It is expected to increase the grade of the mill-heads to $11 per ton and to increase the capacity of the plant to 90 tons per day. Mining is done by the shrinkage-stope system. The concentrate is shipped to the plant of the U. S. Mining & Smelting Co., at Midvale Utah.

Grass Valley.—The 80-stamp mill of the Empire company is again operating at full capacity, the output approximating $90,000 per month. Work in the Pennsylvania mine, which is operated in connection with the Empire mine, is to be resumed. The mules and sundry mine equipment have been replaced in the workings and the stopes and shafts are being repaired. The milling will all be at the Empire plant, an electric railway having been built to transport the ore.

Marysville.—Preparations are under way at the local plant of the Yuba Manufacturing Co. for the building of three large gold-dredges for the construction of which the company has contracts. These dredges will be built at a cost of $3,000,000. Material has already commenced to arrive, and actual building operations will be in progress here by October 1. Several hundred men will be employed in the shops.

Placerville.—Work has started at the Grover mine on Slate mountain near Georgetown. Trucks are being used to haul machinery and supplies to the mine. The Grover has produced some rich ore, but has never been worked to depth. ——Discovery of a deposit of rich gold ore near Kelsey is reported; several nuggets have been found, including two weighing 7 and 5 oz., respectively. The discoverers state that an important deposit has apparently been found.

Randsburg.—The California Rand Silver, Inc., has declared regular dividend No. 20, calling for a distribution of $25,600. This makes a grand total to date of $992,000. The recent monthly report states that the drift on the ninth level has been "in shipping ore for almost the entire distance of 342 ft. with good ore still showing in the face, thus opening the largest body of ore in the history of the mine". During August, 3648 tons of milling and shipping ore was mined, 1465 tons of which went to the smelter. The surplus on September 1 was $314,000. The annual meeting will be held at Bakersfield on September 10.

Redding.—The Valdor Dredging Co. has completed a thorough prospecting of placers along the Trinity river at Poker Bar, below Lewiston, and the officials are considering the advisability of dredging the deposit. The ground is reported to carry a fair quantity of gold. The company is working a dredge near Junction City. A small dredge was operated several years ago at Poker Bar, but was not sufficiently powerful to work the placers to advantage.——Mining of gravels carrying gold and platinum is proceeding along Beegum creek, with many operators said to be realizing profits. High water has hampered activities all summer, but the miners expect to work the lower deposits during the fall months unless early rains set in. The placers have been located for miles along the creek and for a considerable distance on each side.

COLORADO

Alma.—Local operators have secured a lease and bond on the old Russian mine and active operations are planned. ——Supplies have been delivered at the lower adit of the London mine, and the adit, 2200 ft. long, will be extended to the London vein, 2000 ft. distant. The property closed during the war period because of shortage of labor and high cost of mining supplies.

Breckenridge. The Pennsylvania mine and mill are again operating and silver-lead concentrates are being saved for shipment to the A. V. smelter at Leadville.——The King Solomon Syndicate has uncovered a 4-ft. vein of silver-lead ore on the Wheel of Fortune, and a body of manganese ore, 18 ft. wide, has been exposed on another of the King Solomon group at Frisco. The silver-lead ore assays 300 oz. in silver for closely sorted material.

Cripple Creek. Three properties on Ironclad hill, the Jerry Johnson, Forest Queen, and Hardwood, the last named owned and operated by the United Gold Mines Co., are producing and shipping.

Idaho Springs.—Operations have been resumed by the Gem Mining Co. Contractors are starting on the connection with the old workings of the Gem and Franklin mine of the Silver Age group. A strong orebody has already been opened and ore reserves are being increased. The Newton mill has been overhauled and is in shape to receive and treat ores.

Kokomo.—The Kokomo-Recen company is mining ore from a 2-ft. vein recently opened. Assays show as high as 3 oz. gold, 6 oz. silver, and 12% lead. The property has been idle for some years.

IDAHO

Coeur d'Alene. The Federal Mining & Smelting Co. has declared a dividend of 1% on its preferred stock. This is equivalent to approximately $120,000. Payment will be made on September 15.——Preparations are being made to drive a new 5000-ft. tunnel on the Ajax Mining Co.'s property. The Big Creek Mining Co. has added a 60-hp. electric motor and other equipment, and expects to increase the production that has been maintained continuously for several months. G. Scott Anderson is manager.——George MacDonald, contractor for the Caribou Mining Co., has finished his first contract on the tunnel at the mine, and has taken a second contract calling for an additional 100 ft. He is following a well defined vein that may enter the main orebody at any time.

Six feet of galena milling ore has been found on the Hilarity mine of the Pine Creek Mining Co. The body is in quartzite, which is unusual, as many orebodies of the Pine Creek district have been in slate. The strike was made at a depth of 200 ft. H. W. Ingalls is in charge.——The U. S. Silver-Lead Mines Co., operating in the Eagle district, has disclosed ore in both drifts from the lower tunnel level. This is at a depth of 550 ft. on the dip of the vein.——The Columbus Mining Co., operating a mine south of the U. S. Silver-Lead, is developing a body of lead ore 10 ft. wide in a vein 4 ft. wide. The vein contains a little gold and silver. An engine, boiler, and compressor have been ordered and are expected to reach the property soon.

Talache.—The Armstead Mines Co. is now employing 60 men. The company has purchased machinery for a flotation plant, the construction of which will be hastened. Other new equipment includes an air-operated hoist and cage for the main raise and electric signaling system, an underground electric-lighting system, a new air-compressor, six new stoping drills, and a storage-battery locomotive. According to H. H. Armstead a hotel building containing 44 rooms, and a number of artistically designed bungalows, are being constructed. Ore from the Little Joe mine averages 20 oz. silver, 0.1 oz. gold, 1% zinc, 1% lead, and 0.7% copper.

MICHIGAN

Houghton. Commercial and other interests of the various copper districts are taking up the matter of stimulating the demand for copper-made articles, and the slogan, 'Buy something made of copper' is being extensively adopted. Numerous new uses for copper are being suggested and it is likely that some of them will be found practicable. It is believed copper will again come into general use in the household in the form of utensils of various sorts, such as copper pans and kettles, and that more of it, too, will be used for roofing and gutter purposes, water and gas pipes, fencing and screens. Copper signs for highways and copper license plates for autos also have been suggested. Arizona, it is said, will seriously consider the adoption of the auto copper plate for its 1922 or 1923 licenses, and the plan also will be proposed to the officials of Michigan. Out of all the discussion centring about new uses for copper, it is believed much good will come and that new markets will be opened that will ultimately tax the production of the mines. In this campaign it is agreed that the newly organized Copper & Brass Research Association will be a potent factor.

Estimated production of the four companies in the Lake district in August was 4,750,000 lb., divided as follows: Copper Range, 2,300,000; Quincy, 1,000,000; Mohawk, 1,130,000; and Wolverine, 320,000. The output for the summer months has remained at about these figures and probably will continue at this rate until the metal market warrants a decided increase. Present production is less than a quarter of that of 'normal' years, the Lake district turning out better than 20,000,000 lb. per month under favorable metal-market conditions. The figures for the four producing companies are representative of the extent of actual mining operations only. In addition, Calumet & Hecla, which is not mining a pound of metal, continues to operate three furnaces in a cleaning-up process. When mining was suspended, C. & H. had a considerable accumulation of mineral and this, with cupola blocks, is being converted into anodes for treatment in the electrolytic plant, the cathodes being returned for re-smelting into special shapes as may be required in metal orders from abroad.

Copper Range is making no effort to increase its working forces. It is not going 'outside' for men, as has been reported, although it has taken on experienced workers who have come here from the iron districts looking for employment. Places are being found for underground men of experience, whether from this district or others, but no attempt is being made to build up the organization, which is only about half of normal. There has been a considerable labor turnover at all three mines of the company throughout the summer, a condition not unusual during this period of the year. The gain in the payroll at Champion, Baltic, and Trimountain in August was only 20.

MISSOURI

Joplin.—The American Zinc, Lead & Smelting Co. has purchased the High Five mining property near Waco from Temple Chapman and associates of Joplin. The consideration was about $250,000, but under the terms of the contract-sale a long period of years is given for the payment. It is expected that the purchasing company will co-operate with the other producers of the Waco district to drain the ground to a 320-ft. level, 10 ft. deeper than operations have yet been carried on in that district.

MONTANA

Butte.—The Davis-Daly company reports for the quarter ended June 30, total receipts of $257,199, and total disbursements of $171,602, including Federal taxes, leaving a net profit of $85,597. In the first three months Davis-Daly earned a net profit of $59,206. The report says: 'Practically all work at the property not immediately essential has been discontinued and the organization reduced to what seems to be the minimum practicable for single-shift operation. Sunday operation has been discontinued and hoisting of ore is confined to six days per week. The number of tons hoisted per shift operated was probably the highest in the

history of the property, with operating costs low. The grade of ore was a little below the average.

Production at the Hibernia has been quite active and early in June the sinking of the shaft to the 750-ft. level was started, which will determine the grade of the ore. Total development for the quarter, including Hibernia, was 3055 ft., comprising 1122 ft. of cross-cuts, 1051 ft. of drifts, and 882 ft. of raises. The average assay of ore shipped from the Colorado mine was 5.44% copper and 5.31 oz. of silver per ton, and from the Hibernia 26.41 oz. of silver per ton.

The International Minerals & Metal Corporation, that was formerly known as Beer, Sondheimer & Co., has transferred to the Anselmo Mining Co. the following lode claims: Anselmo, Anselmo No. 2, Trifle, Gnat, Hope, and Marquis. The deeds carry revenue stamps, indicating that approximately $900,000 is involved in the transaction. E. L. Ralston is manager of the Anselmo properties, and J. C. Pyle is consulting engineer.

NEVADA

Argentite.—The Natural Soda Products Co. of Inyo county, California, has let a contract for extending a tunnel 100 ft. and for 200 ft. of drifting from the 100-ft. shaft. This work will be done on the Sanger-Taylor, which the company holds under an option. There is a 350-ft. hill on the claims. The vein strikes north through this hill and outcrops on the flat at the northern side. A drift adit has been driven 70 ft. into the northern side of the hill. The shaft is sunk on the flat. A 12-in. width of 1500 to 2000-oz. silver ore has been found on the surface 200 ft. south of the shaft and in what is thought to be the extension of the vein in which the shaft is sunk. A six-mile road connecting Argentite with the main highway has been completed and a 6-hp. hoist, now at Goldfield, will be hauled to the Sanger-Taylor in a few days. E. J. Curless, of Goldfield, has the contract for the 300 ft. of work. W. W. Watterson, of Bishop, president of the Natural Soda Products Co., visited Argentite recently.

Cortez.—A raise is being driven at 60° from the lower or Arctic tunnel of the Consolidated Cortez Silver Mines Co. to connect for ventilation with the Garrison tunnel workings, 360 ft. above. This raise is in the rather soft porphyry composing the big dike that cuts nearly vertically through the mountain. The lower adit exposed high-grade ore in fissures in the limestone, near the main dike. Large blocks on the upper tunnel-level remain unexplored and applicants for leases have offered a 40% royalty to work this territory.

Divide.—The Belcher is to resume work on the 85-ft. level and later it is planned to resume on the 550, where ore has been found in small quantity.

Goldfield.—One hundred tons of $60 ore was produced by the Silver Pick from the winze below the third level and stoping from the bottom has given a production of 150 tons of $40 to $50 ore. Face samples from the stope assay $70 to $80. The ore was 7 to 8 ft. wide in the winze. There is exposed in a 15-ft. raise from the drift in ore on the third level a 2½-ft. width of $100 to $650 ore. A sub-lessee has saved 10 tons of $100 ore from a seam found on the surface and in the hanging wall of the vein.

Hamilton.—The Eureka-Hamilton property on Treasure hill has developed ore on its Pocatello and Argyll claims estimated at nearly $300,000. W. H. Blackburn, engineer for the Tonopah Mining Co., spent a week in sampling the property and is negotiating for the purchase of control. The property is developed by a 550-ft. tunnel and several shafts. A raise and winze from the tunnel are both in good ore. The claims, 17 in number, adjoin the once famous Eberhardt-Aurora mine.

Jarbidge.—The Elkoro Mines Co. is producing at the rate of 100 to 125 tons daily, this being the capacity of the company's cyanide plant.——At the property of the Legitimate Mining Co. gold ore of good grade is being blocked out. Experimental work is in hand, with a view to determining the best process for milling the ore.

Luning.—Prospecting work is being done at a number of points along the porphyry belt at Lucknow, nine miles north of here, and several claim-owners have found good ore. Watson and O'Boyle, discoverers of the ore on the Faith group, have sunk 30 ft., and are sacking $45 ore. The district has a plentiful supply of water from springs, and ore can be delivered to the custom mills at Millers for about $4 per ton.

Mina.—Work on the Mineral county electric-transmission line, extending from Hawthorne to the Simon and Candelaria districts, is making good progress. The hole-digging crew is nearing Simon and the poles and wire have been delivered. The poles were bought in Idaho and were treated with creosote en route in Utah. The county has bought the remainder of the line extending from Hawthorne to Lundy, California, where the power is generated. Branch lines will be required in the near future for operations at Marietta, Garfield, and other districts tributary to Mina.

Western Part of South Dakota, Showing Hill City

Round Mountain.—Lightning destroyed the transformers at the Sunnyside mill of the Round Mountain Mining Co. Three new transformers were obtained within 48 hours at Tonopah and Goldfield and milling was resumed with only brief delay. The mill is operated by lessees on the quartz mine, the company confining its activities to the placer gold deposits. L. D. Gordon, president and manager, went to the property from San Francisco.

Tonopah.—The Tonopah Extension Mining Co. has unwatered the Victor shaft down to the 1880-ft. level and is now making preparations to resume exploration and development work to open up the orebodies that have been developed on every level above the 1760. Several days will be spent in cleaning up the floors of the cross-cuts and drifts and clearing the tracks. It should not take long to prove whether the Murray, the Merger, and the Victor veins extend at least to this depth in the Extension mine.

Peter Oslund, with more than $25,000 to his credit in a Tonopah bank, left here a few days ago for a visit to his old home in Sweden. Oslund made the money leasing on the Halifax. With less than two months remaining before his lease would expire, Oslund's partner quit him. Oslund then decided to invest another and last $50 in the lease and within ten days he opened ore. From then until the lease expired, six weeks later, he shipped ore of a net value to him of $25,000. Oslund is traveling to New York in a Ford automobile which he will take with him to the old country. ——The tailing-treatment plant at Millers of the Belmont is to resume in a few days. The plant, which has a capacity of 150 tons daily, will be in charge of M. A. Tanner.

The Golden State Divide Mining Co. has purchased the surface equipment owned by the defunct Mutual Divide Co. This plant was one of the best erected during the big boom in the Divide district. The purchase includes one mile of power-line, which will be used for connecting the Klondyke shaft with the trunk-line of the power company. When the strike was called the Golden State was shipping 100 tons per week to the Desert mill at Millers. During the four months of the strike the management never lost a shift in the mine, and it is estimated now that the Golden State has 2000 tons of good milling ore a the surface and broken in the stopes.

Tuscarora.—The re-opening of the old mines of this district is again being discussed, Salt Lake men having become interested in the project. These men are considering a plan to develop electric power. The surrounding region has many good sites for hydro-electric plants, with an abundance of water. Rich gold ore has been found in the western part of the district, on claims adjoining the Rose property.

SOUTH DAKOTA

Lead.—The Free Gold Milling Co. has been organized by Denver and Eastern men, headed by D. L. Killen as president and trustee, to take over and operate a property consisting of 16 lode claims, four miles from Hill City, in the Black Hills district. Machinery and equipment is on the ground, together with a stamp-mill of 50 tons daily capacity.

UTAH

American Fork.—Shipments from this district have been delayed, owing to heavy rainstorms, which washed out the road. The American Leasing Co. has been making shipments which average 70 oz. in silver with some gold and lead.——The Mercer-Wild lease at the Dutchman mine has a shipment of 50 tons of ore ready for the market.——At the Pittsburg mine some high-grade ore is being mined and sacked.——At the Comstock property, adjoining the Pittsburg, a winze has been started on a small streak of unusually high-grade lead carbonate ore.——The Miller mine is being operated by New York people under a lease and bond, and a small force is engaged on development work.

Eureka.—Development work has been started at the Tintic-Silver Mining Co.'s property, which adjoins the Lehi-Tintic holdings in the northern part of the district. A fleet of trucks is being used to transport supplies up Broad canyon to the property. It is understood an adit will be driven into the mountain, preparatory to sinking on the vein.

A car of silver bullion recently was shipped by the Tintic Milling Co., which contained between 30,000 and 40,000 oz. The company is securing most of its ore from the old Swansea property. At the present time, the 500-ft. level of the Swansea mine is in good shape for production. Most of the ore so far sent to the mill is material which was caved down during the last 12 years while the property has remained idle. A car of copper bullion was also forwarded by the milling company recently to Eastern purchasers.

Ore shipments for the week ending August 27 totaled 161 cars, of which the Tintic Standard shipped 46; Chief Consolidated, 37; Victoria, 18; Eagle & Blue Bell, 14; Dragon, 12; Iron King, 9; Iron Blossom, 7; Bullion Beck, 5; Swansea, 3; Mammoth, 3; Bowers, 1; Eureka Mines, 1; Gemini, 1; Centennial-Eureka, 1; Uncle Sam, 1; Sunbeam, 1.

At the Victoria property, the orebody previously developed on the 1350-ft., 1450-ft., and 1550-ft. levels, has been entered on the 1700-ft. level, according to William Owens, superintendent. This is by far the largest ore deposit in the mine. A new heading is now being driven on the 1875-ft. level.——About ten lessees are now working the old Grand Central property and shipping 10 carloads per month, according to W. D. Loose, manager.

Frisco.—During the past month four cars of medium-grade ore have been shipped from the Quad Metals mine, according to Grant Snyder, manager. Fifteen men are now employed at the property, and the main development work consists of sinking a winze from the 700-ft. level. Ore running as high as 100 oz. in silver and 50% lead has been shipped. From two of the orebodies—the Carbonate and the Rattler—about $900,000 of metal has been extracted.

Park City.—Concrete foundations for the new concentrating plant at the Silver King Coalition property are in place, and steel construction has been started. Recent developments in the mine, particularly in the O'Brien fissure zone, have been encouraging. In the Silver Hill claim an orebody was recently opened that contains gray copper ore assaying $20 in gold, 150 oz. in silver, and 34% copper.——Ore shipments for the week ending August 27 totaled 1378 tons, as compared with 1212 tons for the preceding week. The Silver King Coalition shipped 593 tons; the Judge companies, 316; and the Ontario, 469.

Sunnyside.—Announcement is made by the Utah Fuel Co. that the fire which has been burning in Sunnyside mine No. 2 since August 17, 1920, has finally been extinguished. The fire was one of the most disastrous, as well as stubborn, in the history of coal-mining in the United States. Fire-fighters worked more than 10,000 shifts before the fire was subdued. The mine had a capacity of 1500 tons of coal per day, and is one of the largest owned by the company.

WASHINGTON

Republic.—The Knob Hill mine is working 10 men and making regular shipments to the Trail smelter, stoping from its new 600-ft. level. The ore on this level is the best ever found in the main vein. Samples taken from the faces of the stopes run high in gold and carload lots average from $25 to $35 per ton at foreign prices for silver.

Colville.—Lessees of the Old Dominion mine in the course of development have shipped to the Trail smelter 133 tons of ore of good grade.

BRITISH COLUMBIA

Alice Arm.—J. and G. Strombeck and A. Miner have found some exceedingly rich ore on the Toric group, on the Kitsault river. The lode, known as No. 2, averages 4 ft. wide and has been traced for 300 ft., but the high-grade ore is 22 in. wide, on the foot-wall side. This ore contains native silver and samples have run up as high as 9600 oz. per ton. An average of three samples from which all visible native silver was removed gave 107 oz. per ton. The No. 1 lode, which runs parallel to the No. 2, is 5 ft. wide and assays 24 oz. in silver per ton. The owners have started a tunnel to cut the new discovery at a depth of 40 feet.

Greenwood.—A local syndicate has been formed for the purpose of building a 100-ton custom concentrator, provided the neighboring mines will guarantee to supply 100 tons of ore daily. Another local syndicate has commenced to develop the Riverside mine, at Rock Creek.

Stewart.—J. J. Coughlan and associates, of Vancouver, have bonded the Silverado group from John Haake, of Stewart, and Stewart Brothers, of Victoria. A substantial

payment has been made. The bond calls for certain improvements in the way of equipment and development. The vein is from 4 to 14 in. wide and contains freibergite. A sample taken by the resident engineer of the Provincial Department of Mines last year gave $10 in gold and 360 oz. in silver per ton and 5% of copper. There are 12 tons of this class of ore sacked ready for shipping. The new owners will establish a permanent camp at the mine and build a light tramway to tide-water, a distance of only 8000 ft. R. L. Clothier has been placed in charge of the development of the property, which is to be commenced at once and continued through the winter.

George Mehlfeld has run into a rich ore-shoot in the tunnel at the Idaho group, on the Marmot river. The tunnel was started on a stringer that has opened out to a good shoot. Assays have run up to 900 oz. in silver.

Trail.—Ore receipts at the smelter for the week ended August 21 totaled 8244 tons, 7940 tons coming from the company's mines. The custom shippers were: Chambers, Sandon, 7 tons; Last Chance, Sandon, 26; Providence, Greenwood, 41; Republic, Republic, 36; Surprise, Republic, 155; Rosebery-Surprise, Rosebery, 38; and Nugget, Sheep Creek, ¾ ton.

KOREA

Unsan.—The report of the Oriental Consolidated Mining Co., for the month of June, shows that 160 stamps ran 25.02 days, crushing 18,820 tons of ore. The gross receipts for the month were $95,-191; operating costs, $82,963; operating profit for the month, $12,228. There was put back into development work $1803, leaving a net profit over all expenditures amounting to $10,424.

MEXICO

Chihuahua.—The Guadalupe group of eight claims, situated in the San Juan mountains of the district of Allende, has been filed on by Julian Sanchez and Juan Aceves, of Chihuahua City. The properties are traversed by some well-defined veins which give good assays in silver, gold, lead, and copper on the surface.

E. A. Reilly and associates of Chihuahua have applied for titles to a group of 20 claims situated in the Lobos mountains near the station of Jiminez. The new location is surrounded by a number of old producing mines, among which are the Romeo, Maria, Centenario, and La Soledad. The ores of this district are principally gold.

M. G. Garner is surveying some recent locations recorded by Jose D. Cruz in the district of Andes del Rio. The survey will embrace the old Santa Maria mines which formerly belonged to Guadalupe Loyo and abandoned during the revolution.

Durango.—Fernando M. Ortiz, of Parral, has applied for new titles to the Sierpe, La Noche, La Aurora, and Elenita mines in the Inde district of this State. These properties were recently declared open for re-location, having been forfeited by neglect of the former owners to pay the taxes. There are a number of old workings which have filled with water. Some of the mines formerly produced good ore and as soon as the old shafts are cleaned out it is expected that shipments will be resumed by the new owner.

The Gran Bonanza mine, in the Ocampo district of the State of Durango, has been forfeited and is to be re-located by H. C. Mieli, well known mining man of this district and Parral.

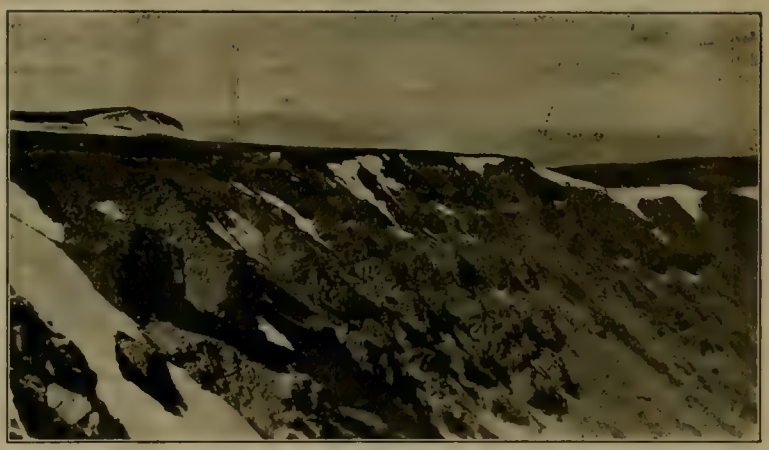
Herbert E. Hambleton, an English mining man in the Guanacevi camp, has added seven new claims to the Culebra and La Verde groups, to be patented under the name of Ampliacion de la Culebra. The survey is being made by Kenneth A. G. Shearer and embraces an extension of some of the principal veins which travers the old claims and which produce a good grade of silver-lead ore.

G. S. Betancourt has discovered a silver-bearing vein in the Animas mountains of the Tamazula district. He is having a survey made of four claims which have been recorded under the name of La Valenciana.

Guanajuato.—A number of the silver mines of Guanajuato and Aguascalientes have suspended operations due to the low price of silver. Among the principal producers which are closed down are the Anguangueo and Zitacuaro. El Favor mine, one of the big silver producers of the State of Jalisco, has suspended operations, discharging a large number of miners and outside workmen.

ONTARIO

Cobalt.—With a force of 105 men, the Coniagas mills are handling 700 tons of ore daily. This is made up of 370 tons from underground, the remainder being old tailing. Production from 2000 tons treated during July reached nearly 200,000 oz. of silver.——The price of Cassel cyanide has been reduced to 19c. per pound from the high point of 21c. during the past two years.



Keno Hill, Mayo District, Yukon Territory

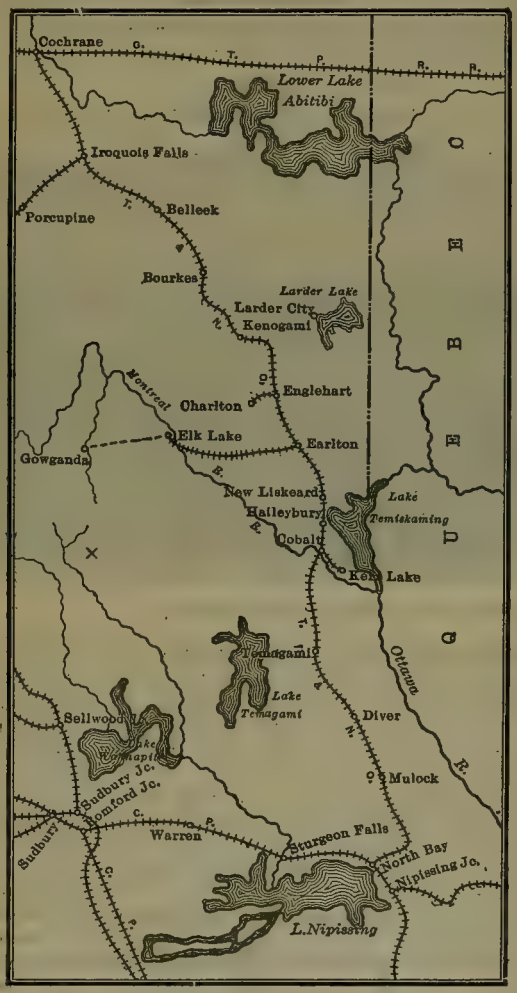
Sandy McIntyre, who discovered the Temiskaming mine fifteen years ago, as well as staking the McIntyre-Porcupine in 1909 and making the first discovery of ore on the Teck-Hughes mine in 1910, has just made another promising gold discovery in the township of Gauthier, in the eastern part of the Kirkland Lake field. The Temiskaming has produced an aggregate of 12,000,000 oz. of silver to date while the McIntyre is producing over $2,000,000 per year and with $400,000 per year from the Teck-Hughes. In each case McIntyre sold out at a comparatively small price.

Kirkland Lake.——Another new vein has been opened up on the King-Kirkland which carries ore at the surface over a length of 200 ft., the paystreak being from one to two feet wide.——Structural work on the new mill of the Ontario Kirkland will be completed in about a month. The machinery is arriving and it is hoped to have the mill in operation by the end of the year. A quantity of ore averaging about $15 gold per ton is in readiness for milling.

Larder Lake.—The Canadian Associated Goldfields has decided to cease operations at Block B (formerly the Harris-Maxwell), where nearly 100 men are employed, in order to concentrate their efforts on Block C and D. Cross-cutting is

under way at the 175- and 300-ft. levels and the shaft is being deepened.

Porcupine.—Shareholders of the Davidson Consolidated, at a meeting held in Toronto on August 24, ratified the sale of the assets of the company to a British syndicate, which will organize a new company to be known as the Porcupine Davidson Gold Mines, capitalized at £1,000,000. Shareholders of the old company retain their securities, and the price paid for the assets is £175,000 preferred stock and £450,000 common stock in the new company and £50,000 cash. A sum of £200,000 is to be set apart for working capital. Unwatering of the mine has already been commenced preparatory to the resumption of operations.



Northern Ontario

Sudbury.—The nickel-mining industry continues inactive and owing to the dullness of the market appears likely to remain so for some time. The International Nickel Co. is operating on a limited scale and is not expected to increase its output before the completion of a new steel plant, which is being erected in the United States.———The Mond plant is merely marking time and it is understod that active operations will not be resumed until exchange conditions are more favorable.———Although an official visit was made to the plant of the British America Nickel Corporation about six weeks ago, no announcement as to the intentions of the company has been made.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

L. W. Storm, of Seattle, is at Great Falls, Montana.

F. Dean Bradley has moved from Goldfield to Tonopah.

K. F. Klein has returned to New York from Alma, Colorado.

Joseph Irving has returned from Jerome to Bisbee, Arizona.

R. V. Thurston, of Payette, Idaho, is at Knoxville, Tennessee.

J. A. McRae is visiting the mining districts of northern Manitoba.

J. F. Callbreath was at Denver last week, on his way to Washington.

Roscoe Edyvean has moved from Bishop, California, to Tonopah, Nevada.

F. E. Calkins has been examining mining properties near Crown King, Arizona.

Walter H. Aldridge has moved his office to 41 East Forty-Second St., New York.

Fred T. Newport has moved from Searchlight, Nevada, to Laguna Beach, California.

S. Paul Lindau is examining mines in the Katherine and Walker districts of Arizona.

A. E. Roberts, recently in Venezuela, is now in San Francisco on his way to New York.

Arthur W. Jenks is in New York. He is expected to return to Berkeley early in October.

W. S. Boyd, manager for the Ray Consolidated Copper Co., at Hayden, Arizona, is at Salt Lake City.

Eugene C. Koenig, superintendent for the Silver Gulch M. & M. Co., at Dunton, Colorado, is at Milwaukee.

Edward N. Greenleaf has been appointed manager for the Allis-Chalmers Manufacturing Co. at Salt Lake City.

Roy Hatch, superintendent of the Arthur plant for the Utah Copper Co., has been in the Yellowstone Park.

J. G. Reilly, superintendent for the Peregrina M. & M. Co., at Guanajuato, Mexico, is at St. Louis, Missouri.

Horace V. Winchell has moved his headquarters from Minneapolis to 1116 Pacific Mutual Bdg., Los Angeles.

F. J. Nagel, mining engineer for the Cia. Minerales y Metales, at Monterrey, Nuevo Leon, Mexico, is at Denver.

W. W. Wishon has just completed an examination of the Henry Ford group of claims in the Oatman district of Arizona.

F. W. Gray has resigned the editorship of the 'Canadian Mining Journal' to join the staff of the British Empire Steel Corporation at Montreal.

H. E. Nyberg, formerly assistant general manager for the Cia. Minera Las Dos Estrellas, of El Oro, Mexico, has been appointed general manager.

William T. MacDonald has returned to Salt Lake City from a trip to south-eastern Utah, where he made an examination of the oilfields in San Juan county.

George T. Hansen, for ten years manager for the Allis-Chalmers Manufacturing Co. at Salt Lake City, has resigned. He will return to his practice as a mining engineer.

R. G. Hall is retiring as general manager for the Burma Corporation, and is to be succeeded by **P. E. Marmion**, lately manager for the Swansea Vale Spelter Company, in South Wales.

G. W. Crane, for several years geologist to the Chief Consolidated Mining Co., has opened an office as consulting geologist at Salt Lake City. He will continue to be associated with the Chief Consolidated company.

THE METAL MARKET

METAL PRICES

San Francisco, September 6

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25
Lead, pig, cents per pound	4.75— 5.75
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

September 5.—Copper is quiet and firmer. Lead is quiet and higher. Zinc is more active and steadier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

	New York cents	London pence
Aug. 30	62.37	38.12
" 31	62.25	37.87
Sept. 1	62.50	37.75
" 2	62.50	38.25
" 3	62.87	38.50
" 4 Sunday		
" 5 Holiday		

Average week ending

	Cents	Pence
July 25	60.14	37.85
Aug. 1	61.66	39.05
" 8	61.46	38.62
" 15	60.81	37.02
" 22	61.78	38.29
" 29	62.10	38.10
Sept. 5	62.50	38.10

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	59.55
Mch.	101.12	125.70	56.08
Apr.	101.12	119.56	59.33
May	107.23	102.69	59.90
June	110.50	90.84	58.51
July	106.36	92.04	59.99
Aug.	111.35	96.23	61.59
Sept.	113.92	83.66	....
Oct.	119.10	83.48	....
Nov.	127.57	77.73	....
Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Aug. 30	11.62
" 31	11.75
Sept. 1	11.75
" 2	11.75
" 3	11.75
" 4 Sunday	
" 5 Holiday	

Average week ending

July 25	12.43
Aug. 1	12.04
" 8	11.75
" 15	11.75
" 22	11.75
" 29	11.58
Sept. 5	11.72

Monthly averages

	1919	1920	1921
Jan.	20.43	19.25	12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	12.74
June	17.53	19.00	12.83
July	20.82	19.00	12.46
Aug.	22.51	19.00	11.71
Sept.	22.10	18.75	....
Oct.	21.66	16.53	....
Nov.	20.45	14.63	....
Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Aug. 30	4.40
" 31	4.40
Sept. 1	4.40
" 2	4.50
" 3	4.50
" 4 Sunday	
" 5 Holiday	

Average week ending

July 25	4.40
Aug. 1	4.40
" 8	4.40
" 15	4.40
" 22	4.40
" 29	4.40
Sept. 5	4.44

Monthly averages

	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.78	4.32
May	5.04	8.55	5.01
June	5.32	8.43	4.57
July	5.53	8.63	4.75
Aug.	5.78	9.03	4.40
Sept.	6.02	8.08	....
Oct.	6.40	7.28	....
Nov.	6.76	6.37	....
Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	30.36
May	72.50	54.99	32.50
June	71.83	48.33	29.39
July	70.11	49.29	27.69
Aug.	62.20	47.60	26.35
Sept.	55.79	44.43	....
Oct.	54.82	40.47	....
Nov.	54.17	36.97	....
Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date	
Aug. 30	4.62
" 31	4.65
Sept. 1	4.70
" 2	4.70
" 3	4.70
" 4 Sunday	
" 5 Holiday	

Average week ending

July 25	4.72
Aug. 1	4.75
" 8	4.70
" 15	4.72
" 22	4.70
" 29	4.65
Sept. 5	4.67

Monthly averages

	1919	1920	1921
Jan.	7.44	9.56	5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	5.49	8.76	5.33
May	6.43	8.07	5.37
June	6.91	7.92	4.96
July	7.78	8.18	4.41
Aug.	7.81	8.31	4.69
Sept.	7.57	7.84	....
Oct.	7.82	7.50	....
Nov.	8.12	6.78	....
Dec.	8.00	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	
Aug. 9	47.50
" 16	47.50
" 23	47.50
" 29	47.50
Sept. 6	47.50

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	50.00
June	94.40	85.00	49.50
July	100.00	88.00	47.75
Aug.	103.00	85.00	47.50
Sept.	102.60	75.00	....
Oct.	86.00	71.00	....
Nov.	78.00	56.00	....
Dec.	95.00	52.50	....

FUTURE OF THE AUTOMOBILE

A thorough painstaking investigation into the present and future status of the automobile industry has just been made by Leonard P. Ayres, vice-president of the Cleveland Trust Co. Many of Ayres' conclusions are rather startling. For example, he found that the capacity of the automobile factories in this country was more than 1,000,000 cars per year in excess of the present demand. If these factories were run at their full capacity for a few years they would soon supply every potential buyer in the United States. There would be so many automobiles in use that the gasoline supply would be inadequate, and some other kind of motive power would have to be developed.

Although the population of the country is about 105,000,000, the greatest number of possible automobile buyers, even by a liberal estimate, is less than 20,000,000. The figure of 20,000,000 is about the number of white American families. It is also the number of persons whose occupations and earning power are such that they might buy automobiles. Not every man who has the price of an automobile will buy one. It seems altogether doubtful if the sale of the higher-priced cars will ever be much more than it is now. Since 1916, the increases in the annual output of automobiles have been largely accounted for by the mounting number of Fords and other less expensive makes. Ayres believes that for several years new users of cars will be confined largely to people of limited means who will buy these less costly machines.

Computations have been made to discover the number of cars in use each year in each division of the country for every 100 native white men above the age of 21, for it is believed that this is a safer basis for estimating possible future domestic markets than most of the others that have been used. The results are presented in the following table:

Cars in Use for Each 100 Native White Men of Voting Age

Division	1912	1916	1920
New England	7	20	42
North Atlantic	5	15	34
East North Central	5	19	45
West North Central	5	25	57
South Atlantic	3	10	35
East South Central	1	7	22
West South Central	3	15	39
Mountain	3	16	45
Pacific	7	24	60
United States	5	17	42

The important fact revealed by these figures is that the number of potential purchasers in this country who are still unsupplied with cars is much smaller than has generally been supposed. Another significant fact is that the use of this criterion for computing the probable limits of the domestic market gives results that vary much less between the different sections of the country than do the figures based merely on the relationship between the number of people and the cars in use. The outcome appears to be, then, that competition between manufacturing establishments will be sharper than ever, and prices of automobiles will eventually be much lower.

MONEY AND EXCHANGE

Foreign quotations on September 6 are as follows:

Sterling, dollars:	Cable:	3.71
	Demand	3.72
Franc, cents:	Cable	7.67
	Demand	7.69
Lira, cents:	Demand	4.36
Marks, cents		1.12

Eastern Metal Market

New York, August 31.

Developments are meagre and demand for most of the metals is light.

Copper has sold at lower levels, but is a little stronger again.

Sales of tin have been good in the aggregate; prices are firm.

The lead market is quiet and steady.

Demand for zinc is very light and prices are lower.

Antimony is quiet and unchanged.

IRON AND STEEL

In the varying reports from different branches of the steel industry the balance is still on the side of betterment in demand, but with no clear indication of progressive improvement ahead, says 'The Iron Age'. Exhaustion of inventories is more marked; this is the occasion of buying. Steel Corporation activities still average a fraction under 30%.

The competitive aspect of the market has not changed, despite widespread reports attributing a more aggressive policy to the leading producer. Actual transactions show that both the Steel Corporation and the leading independent producers are following their practice of many weeks, making such concessions as are required by new developments. The one formal price change of the week was the general dropping to 2.75c. from 4c. on galvanized sheets.

The volume of fabricated steel, which has been a continuing feature in demand, has been large enough to afford tests of price-strength. Tonnage contracts have been written at less than the quoted market. Besides additional orders for car-repair, orders for about 7500 tons of structural material has been closed and 11,000 tons added to what is pending.

Export trade has been better in some directions. Japan is still a steady buyer of black sheets, which are galvanized there. Japan also has bought considerable amounts of sulphate of ammonia from coke by-product plants.

The extent of the decline in steel prices is indicated by 'The Iron Age' composite, which at 2.293c. per pound for finished steel products is now 36% above the ten-year pre-war average, though it was nearly 55% above this pre-war average only two months ago.

COPPER

If sellers were willing to meet the ideas as to prices of prospective buyers as indicated by the number of inquiries, a fairly active buying movement would probably result. Bids by such inquirers are, however, below the quotations of most sellers and nearly all the large producers are out of the market at present levels. Electrolytic copper has sold as low as 11.37½c., but all metal as cheap as this has been sold. The prevailing quotation now is 11.62½c., New York, or 11.87½c., delivered, though perhaps in one or two quarters 11.75c., delivered, could be done. Prospective demand is regarded as good as soon as a definite basis is settled or the bottom of the market for all sellers is reached. Demand which resulted in actual buying is light and foreign sales are not heavy. The Lake copper market is nominal at about 12 to 12.25c., delivered.

TIN

The market is moderately active and firm to higher. For some weeks the price of spot Straits, New York, has held close to 26c., at which level buying has been good in the aggregate. This is true of last week, though yesterday and Monday buying was very light. On each day last week moderate sales were reported, so that the total for the week was of fair proportions. There were certain days when some sellers appeared eager to dispose of their tin. In the business done last week two importers were the principal sellers, with dealers and consumers the buyers. It is stated that one consumer bought 1000 tons direct from the Far East. Prices yesterday were 26.75c., New York, for spot Straits, with London quotations at £156 10s. for spot standard, £158 15s. for future standard, and £157 5s. for spot Straits. Arrivals thus far this month have been 2500 tons, with 3340 tons afloat.

LEAD

Both the leading producers and independent sellers report a good business of moderate proportions at the prevailing prices. The leading interest continues to quote 4.40c., New York, and St. Louis, while the outside market is quoted at 4.40c., New York, or 4.20c., St. Louis, at which levels business is being done. There are no developments of interest, lead being regarded as the strongest of the non-ferrous markets.

ZINC

No improvement is apparent and prices for prime Western continue to drop. Sales have been made as low as 4.12½c., St. Louis, or 4.62½c., New York, which we quote as the market. There are one or two interests which seem to offer the 'market' and there is not enough supporting demand to offset this weakness.

ANTIMONY

In a very quiet but dull market wholesale lots for early delivery are unchanged at 4.50c., New York, duty paid.

ALUMINUM

The leading maker continues to quote 24.50c. per pound, f.o.b. plant, for wholesale lots for early delivery, while importers ask 19 to 20c., New York, for the same grade.

ORES

Tungsten: The situation is unchanged, with quotations ranging from $3 up per unit, depending on the grade and the delivery.

Ferro-tungsten is quoted at 48 to 58c. per pound of contained tungsten in lump form, guaranteed as to quality.

Molybdenum: Quotations are unchanged at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: High-grade manganese ore can be bought as low as 20c. per unit, seaboard, but there is no demand. Stocks in the country are heavy.

Manganese-Iron Alloys: An inquiry for 100 tons of ferro-manganese is the feature of a market in which demand is light and quotations firm at $65, seaboard, for the British alloy and $70, delivered, for the domestic. An inquiry for 350 tons of spiegeleisen is the only one of consequence in a dull market where quotations range from $25 to $27, furnace.

Price deflation has been as drastic in petroleum as in any other large industry, but in recent weeks steadiness has been marked in the general price structure. Prices for crude have declined from 30% in California to 71% in Mid-Continent field, the latter representing 60% of domestic production. Gasoline prices are down 30% from the high of 1920. Kerosene, lubricant, and fuel-oil prices show extreme declines. Demand for fuel-oil for shipping has increased this year over last. Industrial use of oil products, especially lubricants and fuel-oil, has remained low; the market for the latter still remains weak.

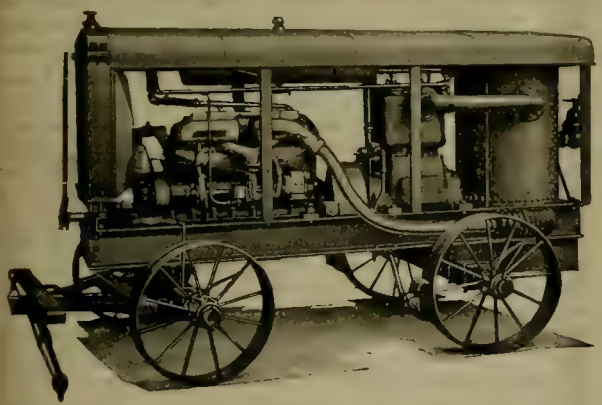
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

AN IMPROVED PORTABLE COMPRESSOR

The accompanying illustration shows a gasoline-driven portable air-compressor, Class P2-DGL, manufactured by the Chicago Pneumatic Tool Co.

Recognizing the demand for a particularly light machine of this kind, the company has developed a compressor ideally meeting these requirements. A study of the construction of this new compressor will indicate that everything possible has been done to create a unit combining large capacity with light weight, plus a simplicity which removes the need for a specially-trained operator. Although compact and very light in weight, this new unit is built of highest quality materials. It is presented with the assurance that it will give the same full measure of satisfaction that has characterized the company's older types of portable air-power plants. The compressor is of the two-cylinder single-acting vertical type. The cylinders are cast en-bloc and are entirely water-jacketed. They are fitted with 'simplate' flat-disc inlet and discharge valves which, together with the low clearance, account for the high efficiency obtained. The crank-case is completely enclosed and is provided with large openings for inspection, cleaning, or adjustment. The bearings, which are cast integral with the crank-case, are accessible and can be easily adjusted by means of liners. Baffles are provided to prevent an excess of oil from working above the pistons into the cylinders.



Chicago Pneumatic Tool Co.'s Improved Portable Compressor

The crank-shaft is of the best grade of open-hearth steel, forged by hand. The connecting-rod is a drop-forging, also of open-hearth steel. It has a solid eye, brass-bushed at the piston-end, and an adjustable babbitt-bushed eye at the crank-end. The differential unloader is positive and dependable in its operation. When it operates it admits air from the receiver to a small plunger in each inlet-valve, holding the valves open and allowing the air in the cylinder to return to the atmosphere.

The air-compressor is direct connected to a tractor-marine gasoline engine of the four-stroke-cycle, four-cylinder type, equipped with a high-tension magneto, a water-circulating pump, a force-feed lubricator, a specially-designed governor, and a muffler. No battery is required—the engine starts on the magneto. A ratchet hand-lever is furnished for starting.

The fuel-tank, which is of galvanized iron, has a capacity of 20 gal., and is suspended from the canopy top, permitting positive gravity-feed of the gasoline at all times.

The speed of the engine is controlled by the auto-pneumatic throttle, an exclusive feature, which, working in conjunction with the engine-governor and the differential unloader of the compressor, throttles down the speed of the engine when the compressor is unloaded and thus saves fuel and lubricant, and also allows the circulating water to increase its cooling effect. When the pressure of air in the receiver drops and the compressor resumes its work, the auto-pneumatic throttle instantly speeds up the engine to normal speed, much after the manner of the accelerator of an automobile.

The compressor and the engine-shaft are connected by means of a high-grade flexible coupling, which compensates for any irregularity in the alignment of the two shafts and for unequal wear of the compressor and engine bearings, and also serves as a fly-wheel. The fly-wheel is designed to produce the proper inertia effect without adding unnecessary weight. Its rim is marked to aid the operator in re-timing the gasoline-engine valves if they should ever require adjustment.

Thorough cooling of the compressor and engine is effected by a positive and reliable system. Two centrifugal circulating-water pumps, one driven from the magneto shaft and the other belted to the compressor crank-shaft, force water through jackets of liberal size and through a large radiator, which is cooled by a powerful fan belted directly to the engine-shaft.

A receiver of large capacity is mounted directly on the truck and is equipped with safety-valve, drain-valve, discharge-valve, and pressure-gauge.

The entire equipment is firmly mounted upon an all-steel truck, having a steel-plate canopy top and sheet-steel sides which completely enclose the outfit. The sides can be locked in place. The frame of the truck is made of heavy 8-in. steel channels. The front wheels are 28 in. and the rear wheels 30 in. diameter; all wheels are 6 in. wide. The tread is 4 ft. 8 in. Two clamps are provided for clamping the channels to the front axle so as to reduce vibration. The outfit is furnished complete with tongue, single- and double-trees, and a reliable hand brake.

BUY SOMETHING MADE OF COPPER

A letter signed by J. L. Harmon, manager for the Mine & Smelter Supply Co. at El Paso, says in part:

"To the Boosters of the South-West:

"Here is a big idea we all should put over:

" 'Buy Something Made of COPPER'.

"Every one of us in the great South-West either directly or indirectly owe a great amount of our bread and butter to the copper industry.

"Now that the copper market is dull it is just the time

for all of us to pitch in and enliven the trade. We can make a demand for this product if you will lend a hand.

"Here are a few ideas:

"Stamp your outgoing letters 'Buy Something Made of COPPER'. A rubber stamp will do.

"In your advertisements insert 'Buy Something Made of Copper'.

"Put cards in your windows, 'Buy Something Made of Copper'.

"Display copper wares in your windows. Make attractive and original counters in your store. Electrical dealers have a great opportunity to boost the game. Here's where the ball starts rolling. Make everybody read, say, or think 'Buy Something Made of Copper'."

COMMERCIAL PARAGRAPHS

The American Steel & Wire Co. has appointed H. S. Durant as sales agent, and M. W. Floto as assistant sales agent, at its Detroit office, to succeed M. Whaling and T. J. Usher Jr.

Edgar L. Keithley has established an office at 1323 Alaska Bdg., Seattle, Washington, as a representative of the **Central Foundry Co.**, makers of Universal cast-iron pipe, soil-pipe, and general castings.

The Pittsburgh Instrument & Machine Co. has issued an attractive illustrated catalogue entitled 'Engineers' and Surveyors' Instruments and Accessories'. A complete line of such equipment is manufactured by the firm at its factory and laboratories at 40 Water St., in Pittsburgh, Pennsylvania.

George T. Hansen has terminated his connection as district manager for the **Allis-Chalmers Manufacturing Co.** at Salt Lake City, effective September 15. He will engage in his personal mining and oil enterprises and will handle rubber-lined sand-pumps which have been patented by him and licensed to the Allis-Chalmers company and to the **Byron Jackson Iron Works.**

'Short Cuts to Power Transmission' is a neat little publication prepared by the **Flexible Steel Lacing Co.** No one who reads it can fail to pick up many valuable points regarding belting and belt-lacing. The publishers seem willing to let good-will accrue toward their product from the reader's appreciation of their efforts to help him, rather than devoting an unusual amount of space to their Alligator steel belt lacing. Copies may be had by addressing the Flexible Steel Lacing Co., 4653 Lexington St., Chicago.

The Dodge Sales & Engineering Co., of Mishawaka, Indiana, announces that the excavation for its new $1,000,000 building in New York City, at 49 Park Place, is practically completed. The new building will occupy 165 ft. on West Broadway, 50 ft. on Murray street, and 75 ft. on Park Place. Present plans call for twelve stories, but foundation and construction will permit of an additional four stories if needed. The basement of the building and part of the first three floors will be used by the Dodge Sales & Engineering Co. as a warehouse, and for the sales and distribution of Dodge, Oneida, and Keystone products for the mechanical transmission of power, covering both domestic and export needs. The products of the Dodge Sales & Engineering Co. include pulleys, rope-drives, hangers, shafting, bearing, couplings, and heavy oil-engines, and are all distributed, in the main, through six hundred dealers who draw from the various branches of the organization situated in nearly every large city in the United States.

E. I. du Pont de Nemours & Co. has just issued a folder describing in detail the qualities of 'Minefab', its new covering for concentrating tables. The du Pont company is, of course, well known as having manufactured for more than a hundred years explosives for mining purposes, but it is also an important maker of coated fabrics. This work has involved the development of a large number of special fabrics for varied industrial uses and has led to the production of 'Minefab'. 'Minefab' is described as a specially treated fabric of great tensile strength, made permanently impervious and flexible by the thorough impregnation of both its surfaces with a non-deteriorating waterproof compound, highly resistant to chemical action and to abrasion. It is stated to be the only material ever made for the specific purpose of covering concentrator tables. A long period of service tests which gave the most satisfactory results have led the company to recommend it as thoroughly satisfactory for the treatment of all ores.

'Duroloid' grinding-balls are a superior type of grinding-ball, cast from an alloy of steel with a base of white iron which contains a high percentage of combined carbon. The high-carbon content of the iron used in manufacturing 'Duroloids' produces such an extreme degree of hardness that it is almost impossible to scratch one of them with a steel tool. This quality of extreme hardness makes 'Duroloids' the ideal medium for reducing ore to any degree of fineness. 'Duroloids' are cast in such a way that the iron crystals radiate from the cores of the balls; thus, only the ends of the crystals are exposed, wear is reduced to a minimum, and chipping becomes impossible. Each ball is tested by hand for hardness and defects before it leaves the manufacturer, thus assuring the purchaser perfect balls in every case. A daily analysis of 'Duroloid' metal keeps the quality of the balls absolutely uniform. 'Duroloids' are made in sizes ranging from ¾ in. to 3 in. diameter. They are made by the **Los Angeles Foundry Co.**, at Los Angeles, California.

The Allis-Chalmers Manufacturing Co. has issued a new bulletin, 1106A, entitled 'Type 'E' Direct-Current Motors'. This new line of motors has been designed for belted as well as direct-connected applications and is particularly suited to exacting requirements. It is a complete new line throughout, no attempt having been made to re-design old apparatus or to employ parts from any previous machines. The new Type 'E' motors incorporate the latest and best features of direct-current engineering practice and are backed by nearly thirty years experience in the design, construction, and commercial application of motors for practically every industry. Among the important features are the following: Ratings and speeds corresponding to standard 60-cycle induction motors; a complete line of constant and adjustable speed-ratings; rugged cast-steel yokes; commutating poles, ensuring sparkless commutation; dust-proof bearings; windings treated to resist oil and moisture; thorough ventilation; conduit boxes on all motors; improved box-type brush-holders; standard enclosing covers; interchangeable parts; and all parts easily accessible.

An all-steel chassis, low over-all height of the body (60 in.), and heavy duty Hyatt high-speed roller-bearings are distinguishing features of the new Miami slow-speed tractor-drawn trailer manufactured by the **Miami Trailer Co.**, of Troy, Ohio. The tractor-drawn reversible hauling-trailer has demonstrated that under many conditions it will deliver material at a lower cost per ton-mile than any other equipment. In this new trailer the Miami company claims to come nearer to realizing full efficiency from this type of hauling-equipment than any other manufacturer has yet attained. The chassis frame is made of 6-in. channel-steel, securely riveted at corners and cross-members, using heavy corner irons and angle reinforcements. Hyatt bearings are protected on the inside and outside by dust-collars, and are adjusted for end-thrust. The Alemite system of lubrication is employed. Every bearing is equipped with Alemite grease nipples and each train of wagons is provided with an Alemite grease-gun. A train of six wagons can be lubricated by one person in from 10 to 15 minutes, ensuring perfect lubrication to every part.

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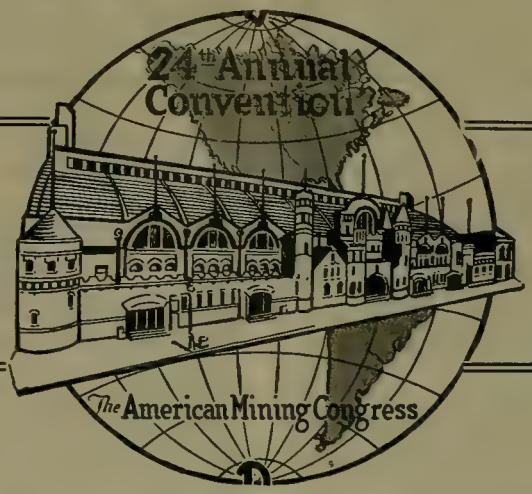
National Exposition

OF

Mines and Mining Equipment

CHICAGO, ILLINOIS,
October 17-22



Two Hundred Representative Manufacturing Firms Exhibiting the latest Forms of Mine Equipment and Machinery.

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THE MINING INDUSTRY IS FUNDAMENTAL TO NATIONAL PROSPERITY

The Twenty-Fourth Annual Convention
The American Mining Congress

Convention Headquarters:
Congress Hotel, Chicago, Illinois

IMPORTANT NOTICE: Some Exhibit Spaces are yet available.
Both the Convention and Exposition will be held at the Coliseum.

Courtesy of
Mine and Smelter Supply Co.

T. A. RICKARD, • • • • Editor

DISPATCHES from Australia announce two gold rushes, one to the Hampton Plains district of Western Australia and the other to Glen Innes in New South Wales. Details are lacking. We hope the discovery may prove important, for nothing would give a better fillip to mining than the development of one or two new districts.

WE were asked the other day how much copper is being produced by the mines in Central Africa controlled by Belgian and British capital, the fear being intimated that the production from that source might prove a menace to the American market. In June the Union Minière du Haut Katanga, owning the Tanganyika copper deposits, made its record output, namely, 3189 tons of metal.

THIRTY-THREE foreign countries imported machinery from the United States during the month of July; the purchases of 13 of these exceeded $5000 each, according to a statement recently issued by the Department of Commerce. Each of 11 others spent more than $5000 for oil-well machinery, which, according to the arbitrary classification of the Department, is summarized separately. This makes 24 different countries, scattered in every continent, that did more than a nominal business with manufacturers of this kind of machinery in the United States during that particular month. July was in no way exceptional, and doubtless the records for a year would show highly profitable dealings with 50 foreign countries. These data indicate the widespread appreciation and use of American-made machinery in every part of the world.

GENERAL PERSHING'S rebuke to Mr. Samuel Gompers will have been read approvingly by many thoughtful citizens. It was poor taste on the part of the president of the American Federation of Labor to use the Lafayette-Marne celebration as an occasion for glorifying his monster union and claiming that it played a decisive part in winning the War. The men who won the War are lying in their graves scattered over more than half of Europe, not to mention Asia Minor and the seven seas. We agree with the General that it is about time to say "that America shall be governed and ruled by American citizens, and not by this organization or that organization, which may have selfish purposes to serve". That includes not only the American Federation of Labor but the anthracite trust, the beef trust, and the powder trust. For our own part we consider that the good work done by organized labor during the War is overshadowed by the unholy profiteering in which it indulged at the expense of the country during a great crisis.

IN regard to the required payment of $50 per acre in lieu of assessment work, as specified in the Bill to amend and codify the United States mining laws, we are informed that this provision was made for the following reasons: Under the present law a discovery of valuable mineral is an essential prerequisite to the validity of a mining location. Under the proposed new law, however, claims may be located without discovery and held for five years by the performance of labor annually to the amount of $5 per acre or the annual payment in cash of $5 per acre. In drafting the proposed law it was thought that locators ordinarily should not be permitted to hold claims without a discovery for a period longer than five years. With the idea, however, that there might be cases, for instance, of valuable improvements having been placed upon the locations, which claimants therefore might desire to hold beyond the period of five years, it was provided that they might do so upon the payment of $50 per acre annually. This heavy annual assessment was fixed with the idea of discouraging the holding of mining claims without a discovery beyond the period of five years; at the same time it was designed to avoid the incidence of possible hardship under special circumstances, at the termination of the five-year period.

MANY of our readers have doubtless received 'literature' from a genial gentleman who points the way to a substantial fortune by the investment of a few dollars in companies that control sundry portions of the expansive surface of western Texas, beneath which there is a "chance" of finding valuable deposits of potash. The inference of the promoters is that the chance is excellent; we venture to surmise that, in any specific area, it ranges from highly improbable to remotely possible. Perhaps we are pessimistic. The U. S. Geological Survey, in co-operation with the Bureau of Geology at the University of Texas, has been investigating for several years the possibility of developing valuable deposits in the 'Red bed' region of western Texas and parts of adjoining States. The principal source of information

has been the work of oil-well drillers, some of whom, in a rather haphazard manner, have preserved samples of the sludge from their drill-holes. Several of these were found to contain potash in proportion as high as 9%. At the time these samples were taken, the holes were from 1600 to 2425 feet deep and the most widely separated of the three principal wells were 125 miles apart. The Government geologists warn the public that the conditions of drilling and sampling at all three points are unsatisfactory, and that it remains to be seen whether the beds that are rich in potash are thick enough to justify mining with any hope of profit. They declare, however, that the indications are sufficiently encouraging to warrant thorough testing with core-drills, principally because of the tremendous importance to the whole United States of proving the existence of workable deposits of potash.

INTROSPECTION is good for any of us. The article by Mr. Edwin Higgins that appears in this issue should prompt at least one man in every mine organization to analyze himself and his job. It contains germs of thought that may be cultivated profitably by the technical men who specify the materials and supplies that are required for the operation of mines and reduction plants, but it is the purchasing agent, in particular, who should be stimulated to make a searching examination of his own temperament, his own methods, and his own attitude toward his work. As Mr. Higgins says, the "successful purchasing agent must have most of the virtues known to man and none of his defects". We venture to suggest a few principles that Mr. Higgins does not emphasize, but that may well guide the man whose business is to buy. He should obtain exactly what is specified by the superintendent or foreman who is to use the material; something else may be just as good or even better, but the wise purchasing agent will buy according to the requisition; his duty is to obtain the best possible price, not to select the kind of machine or material to use. This does not mean that he should not give the superintendent the benefit of any information that he may obtain regarding other products; but rather that he should leave the question of preference to the man who must get results from using the things purchased. A successful purchasing agent will make business friends of the salesmen with whom he deals. They usually know more about their particular 'line' than he does, and their goodwill is a great asset, just as their dislike may easily prove to be disastrous. An illustration is seen in the following experience of a purchasing agent who was overbearing and arrogant in his dealings with the salesmen who sought his business. He was generally hated by all of them for this attitude and for his belief that he knew the technical details of their business as well as they. He received a requisition for several miles of copper wire "or its equivalent in electrical-carrying capacity of aluminum wire". His duty to his employer, obviously, was to purchase whichever material was cheaper, provided it would do the required work. After obtaining quotations on both materials from a number of firms, he purchased the copper wire as being, so he thought, the more economical. It happened that, with the price of copper prevailing at the time, aluminum would have been much cheaper for the particular purpose for which this wire was to be used. He had taken into consideration the difference in conductive capacity of the two metals but had neglected to allow for the difference in specific gravity, which was an essential point because the quotations were given in cents per pound. Four different salesmen deliberately had let him fall into the error because of the resentment they cherished against him. The company wasted several thousand dollars; the upshot was that a little later the purchasing agent lost his job. A wide detailed knowledge of commodities and machines and supplies is desirable, but, as in most spheres of life, a sympathetic understanding of human nature and a decent treatment of the men with whom one comes in contact will go a long way toward compensating for a lack of technical information; they are *the* essential assets of a good purchasing agent.

STATISTICS published by the newly-formed Division of Electrical Machinery of the Department of Commerce indicate the growing importance of one of the principal branches of our export trade. For the fiscal year 1914-1915 the exports of electrical machinery and appliances amounted to $19,722,000. For the fiscal year 1917-1918 they had advanced to $54,547,000; for 1918-1919, to $80,000,000; for 1919-1920, to $87,000,000; for 1920-1921, to $119,221,000. This increase is all the more significant because it is much greater than that which occurred in any other division of machinery exports. Further, the actual amount exported during the last period cannot be gauged by the value; for prices in many instances were less than they were during the previous period. Electric lamps were exported to all parts of the world; telephones valued at over $6,000,000 went to over 60 different countries; 88,000 electric-fans were distributed among more than 70 countries; electric heating and cooking apparatus went to over 50 countries and colonies. The electric-motors exported were valued at over $18,000,000; the dynamos and generators, at about $17,000,000; and the insulating wires and cables, at over $11,000,000. The United States is electrifying the world; the demand for electric equipment is an evidence of advancing civilization in other countries. Colossal plants for the utilization of the water-power that is now being wasted in South Africa will soon be considered as essential to the proper progress of that part of the world and for the conservation of the industries that are now on the wane. Other countries will follow suit. Every piece of American electrical machinery that is sent abroad will do missionary work and will help to hasten the coming of the age when the economization of man-power, by the substitution of hydro-electric or steam-electric energy, will be recognized as the height of efficiency. The demand for copper when the electrical age is reached throughout the world will be enormous.

Cost of Mine Supplies

A mining engineer, connected with several small but promising enterprises in California, writes a friendly letter to question the accuracy of a statement made recently in an editorial paragraph in which we expressed the opinion that many idle mines in California soon would resume operations for the reason that "the decline in the cost of supplies and in the rate of wages has improved conditions considerably". The assertion with which he takes issue is that relating to the reduction in the cost of supplies, although he confesses that he is not so sure of his ground as to wish his letter published. For that reason, also, we refrain from mentioning his name. He says: "I believe if you will take the following articles as representative of mine material you will be unable to figure an average reduction of 5% during the year: machine-drills and parts, carbide, blacksmith's coal, drill-steel, oil, packing, mine-cars, rail, pipe, powder, fuse, and caps. On the first seven articles mentioned I do not believe there has been any reduction in price". He then suggests that we print "a short list of materials showing the percentage of increase or decrease in the price of each". Although the statement to which our correspondent refers was general, it was based on definite information, as will appear from an inspection of the following specific comparisons, in which are included not only the items that he has listed but some others that indicate the downward trend. Nearly all these figures were obtained from the purchasing agent for an important group of mines that has its main office in San Francisco; they represent actual purchases made during August 1920 and August 1921 and are accurate.

	August 1920	August 1921	Decrease, %
Rock-drills, a standard sinker	$170.00	$170.00	0.0
Carbide, per ton	155.00	155.00	0.0
Blacksmith coal, per ton	34.00	31.00	8.8
Drill-steel, hollow round, per lb	0.19	0.16½	13.2
Fuel-oil, in tank-cars, per bbl	2.20	1.60	27.3
Packing, a standard kind, per lb	1.05	0.92	12.4
Mine-cars, a standard car	189.00	134.50	28.8
Rail, in ton lots, per 100 lb	5.00	3.25	35.0
Pipe, black, standard 2½-in	41.15	28.20	31.5
Powder, 40% gelatin, ton lots	21.25	19.00	10.6
Fuse, standard brand, per M ft	18.78	16.66	11.3
Caps, No. 6, per M	10.20	8.50	16.6
Mine timbers, Douglas fir	36.00	23.00	36.1
Copper wire, weather-proof, per lb	0.42½	0.20½	51.8
Wire-rope, plow-steel, 6–19, per ft	0.29	0.25	13.7
Rubber belting, a standard brand, per ft	0.95	0.71	25.2
Average decrease, %			20.14

With respect to rock-drills it may be said that the peak was reached in 1919, when prices averaged about 70% higher than in 1913. As compared with most equipment of similar character the increase was moderate; this fact is advanced by manufacturers as justifying the retention of prices today that are identical with those of 1919 and of 1920; nevertheless we feel safe in predicting that the diminished cost of the alloyed steels and other semi-finished materials and of skilled labor required in the manufacture of rock-drills will result in a lower schedule of prices early in the coming year. Carbide is the only other item that has remained stationary, and blacksmith coal is the only other one in which the drop during the past year has not exceeded 10%. Carbide comes from Sault Ste. Marie, and good blacksmith coal comes from collieries east of the Mississippi. Obviously, high freight-rates are an important factor in determining the prices on the Pacific Coast of these commodities, as well as of other bulky supplies that must be shipped a long distance. We do not mention this as being particularly pertinent to the present discussion; it makes little difference to the mine operator on the Mother Lode, for example, whether the manufacturer or the railroad gets his money; what concerns him is the cost of things delivered at the mine. Some of our friends, however, may not know that carbide is shipped 3000 miles to California. Glancing down the list it will be noted that rail and pipe have been reduced one-third, and that mine-timbers of Douglas fir cost only 64% of what they did. The influence of freight-rates is shown here also: at the mills in Oregon the price for fir, of No. 1 mining grade, is now $10 as compared with $23, or considerably less than half that prevailing a year ago. It is a fair assumption that during the next year there will be a general readjustment of railroad rates, which necessarily will be reflected in a reduction in the cost of many commodities. Other economic forces are working toward the same end. We feel justified, not only in reiterating the statement to which our friend took exception, that "the decline in the cost of supplies has improved conditions", but in venturing the prediction that there will be a further decline, with a continued improvement of conditions from the miner's standpoint; and, moreover, that this decline can proceed for some time before there will be any but a wholesome effect on the industrial prosperity of the country at large.

The Disarmament Conference

No more important subject has been presented for the earnest consideration of the present generation, not even during the recent tragic years of the Great War, than the international conference that is to assemble at Washington on the anniversary of the Armistice. The date itself brings suggestions that provoke thoughtful men to sombre retrospect, for the jubilation that marked November 11, 1918, proved premature. The War did not end wars and the Armistice did not bring peace. Instead, several new wars were started and several new controversies were developed. Among these are the "Pacific and Far Eastern problems", to which special reference is made in the note that the President sent to the governments of Britain, France, Italy, Japan, and China, when inviting them to take part in a conference on "the question of limitation of armament".

It is said, by Mr. Mark Sullivan, that "Washington understands the importance of the coming disarmament conference, although it seems the country does not". We are loath to believe this. On the contrary, the signs multiply that the peoples of the earth, not the American people alone, are keenly aware of the tremendous issue that is to be settled next November. Even the Peace Conference at Paris was not more momentous, and if importance is to be measured by definite results we hope fervently that the Washington Conference will prove much

the greater event. One reason why the representatives of the various nations at Paris failed so miserably in effecting a real peace was that they tried to do too much; another was that bitter feelings and jealousies were permitted to come between both the late enemies and the recent allies. Since then the world has suffered a sad disillusionment; the confident hopes of 1919 have burned to ashes; the miscarriage of noble ideals and pious aspirations has taught us a lesson. We realize that the recent horrible war has not put an end to the chances of a further conflagration; on the contrary, it has become clear that in the future it will be impossible for two powers to engage in conflict without dragging the whole of the civilized world into another Armageddon. In the future, war will not be restricted like a fire in a paddock, it will be like a prairie aflame in late summer or a pine forest burning in the path of a hurricane. Another fact is manifest: the cost of preparedness for war, on a scale heretofore thought necessary, cannot be borne by the nations of Europe: the cost is breaking Japan; even a country so rich as the United States feels the burden of it. Our people are irritated by the taxation rendered necessary by the last war, and are beginning to realize what it means to maintain a policy of preparedness for the next. Of the revenue of this country 91% goes to pay for past or future wars; the cost of one battleship represents more money than the entire sum set aside by the Federal government for education. Indeed, the waste of capital is one of the features of warfare on a big scale that we are beginning to appreciate. In future, unless reason prevails, wars will not be contests between professional armies, they will be fights to the death between organized peoples, they will be backed by the entire industrial resources of the countries involved. The loss of life on the battlefield is realized, although not deeply enough; on the other hand, most of us are hardly awake to the industrial loss arising from the withdrawal of young manhood from productive labor, not only during war but during the long period of preparation that precedes actual fighting. Still less is it realized how enormous is the wastage of capital, the destruction of things that have cost years of labor, and that cannot be replaced except by the spending of an equivalent human effort. The devastation done by the German armies in northern France is but a sample of what may be expected, for it is certain that in any future struggle all the checks of civilized convention and all the restraints imposed by decency will be ignored, as they were in the last war, and we may expect that effectiveness will be the sole purpose of the methods and materials employed. Among the probable horrors is the wireless control of aeroplanes loaded with explosives in such quantity and of such violence as to beggar even an imagination fed with the memories of Messines and Vimy or reminiscent of the attacks upon Paris and London—as if duelling were still in fashion and gentlemen were to decide a point of honor by the aid of machine-guns. Indeed the searing thought of the destruction likely to result from another Armageddon is intolerable to any sane mind. The possibility of it must be removed. We owe it to our children. This is the land of our fathers and of the gallant forefathers who founded it, but it is well to recall the even more pertinent fact that it is the country of our children. We owe it to them that their lives shall not be sacrificed to Moloch. We have another debt also. Did we not tell our young men that the late struggle was to be a war to end wars, and did we not send them forth with that slogan to cheer them in the trenches? They were told they were crusaders fighting to rescue the cross from the heathen; they were the defenders of civilization and the heroes of a new dispensation. Have we fulfilled our part of the agreement? No, not at all. The war that they helped to end has been followed by no sure settlement; by no disarmament; on the contrary, it has been followed by many new clashes, by piratic invasions, by disagreements and bickerings that will prove the precursors of more wars unless the whole matter is taken seriously in hand. The living have broken faith with the dead; it is for the peoples of the earth—for our own in its proud leadership—to remember those who lie in Flanders field and to erect to our own unreturning dead a memorial more glorious than brass and more enduring than granite. The only memorial worthy of them is the fulfilment of the purpose for which they died.

Dwellings in Mining Settlements

The fact that beauty need not always be divorced from utility is evidenced in the plans that were made and carried out for an attractive settlement at Rosita, in the State of Coahuila, Mexico, where the American Smelting & Refining Company operates coal mines and by-product plants. The architectural work was undertaken by Mr. H. E. Skougor, of New York, and an account of the new township is given in a recent issue of 'Coal Age'. Suitable housing was provided for the entire staff, from the general manager to the humblest *peon*. The following houses serve to accommodate a force of 31 Americans and 1173 Mexicans: One manager's residence; eight houses for department heads, accommodating the operating engineer, the chief surgeon, the mine superintendent, the chief accountant, the superintendent of the by-product plant, and the welfare superintendent; 14 houses for division heads, accommodating the master mechanics, the chief draughtsman, the chief electricians, the coal-washery superintendent, and assistant superintendent of the by-product plant, the mine foreman, and the power-house engineer; two hotels, one to accommodate 18 single American men, and another for 12 single Mexican men; 10 residences for American married clerks and foremen; 45 houses for Mexican mechanics (married), two families in each; 208 houses for married Mexican miners and laborers, four families in each; and 21 *excusados*. Public buildings included a community centre, theatre, public market, school, hospital, and church. The buildings were constructed of adobe brick, plastered, with wood-shingle roofing.

The community building accommodates the railroad

station, telegraph and post offices, the company's commissary, and a public restaurant and sleeping-rooms. The theatre has a seating capacity for 500; the club for the Mexicans contains a bowling-alley, pool-room, barber-shop, assembly-rooms, and public baths. A Roman Catholic church and a residence for the priest are provided. Schools, hospitals, fire-stations, and offices for a camp manager and a *presidente* complete the township. A feature of the design has been an adherence to the Colonial-Mexican style of architecture. Monotony in appearance has been avoided in those cases in which many houses of the same size were needed by designing them of several different types. The dwellings for miners and laborers, for instance, have the same floor area and general arrangement, but seven distinct types have been adopted. The appearance of the town, to judge from the architect's drawings that accompany the description, is such that the article in question should be consulted by all who are interested in the planning of attractive homes for mine employees.

The subject of suitable dwellings for workers in isolated districts, at home or abroad, is one of general interest, although usually given but scant attention. Few corporations are in the position to engage the services of an engineer and architect for such work: it is seldom that a complete town can be planned at one time. The result is that many mining camps suffer because of the crudity of design of the buildings. There are exceptions, but these are found usually on the properties of the larger and more influential corporations. It is not by any means a question of cost only. Convenient and comfortable dwellings can be constructed from cheap materials; in many places an adobe is made of the residue from the mill, with or without the addition of cement. Attention was drawn, a few years ago, to the feasibility of using rammed earth in the construction of walls for dwellings in mining camps, especially those in isolated districts and in foreign countries. This *pisé de terre*, as it is called, has been found entirely satisfactory, but it has been adopted only to a limited extent in place of the more expensive materials. In Rhodesia, one-third each of ant-heap, soil, and sand are used; the mixture is incorporated with water to form a moldable mass. A set of wooden forms, which can be used to make an almost indefinite number of houses, is erected on the site chosen, and the mixture is thrown in and rammed. Clay, ashes, and clinker have also been used as one or more alternative components of the mixture. Ceilings can be made of the same material, with the aid of small-mesh wire-net. Such construction has been proved to be unusually permanent, even in countries where heavy rainfall is common. The thickness of the walls is usually about 14 inches for a height of about 12 feet, the result being that the buildings are warm in winter and cool in summer. If an engineer with Mr. Skougor's artistic perception could give us some simple designs for standard types of dwellings that could be built by the *pisé de terre* method it is certain that mine managers in isolated localities would welcome an opportunity to combine attractiveness with utility, without sacrificing the economy that must ever be an essential of such outlays.

The Kata-Thermometer

The progress of science indicates a growing appreciation of exactness, a distrust of vague generalities, and a desire to be able to speak accurately on each and every subject. To do this it is realized that quantitative estimations as well as qualitative tests are necessary; and such are usually obtainable only after the scientist has developed the apparatus that is required. The microscope was used, soon after its invention, in support of the fallacy called 'spontaneous generation', but that was due to unscientific interpretation. The ultro-microscope has been of immense value to investigators of colloids and their characteristics. The thermometer and the pyrometer made possible the exact measurement of temperatures. The kata-thermometer permits a scientific estimate to be made of the cooling-power of winds and air currents. It was used first in connection with investigations in factories, and was later adopted for use in the deep mines of the Witwatersrand. Occasional mention of it will be found in technical literature, and it was described at a recent meeting of the Institution of Mining & Metallurgy in connection with the discussion of a paper on deep mining; but many mining engineers know little about the design or construction of the instrument, or appreciate the principles on which it was evolved.

One of the earliest experiments on the effect of cooling, made by Dr. Leonard E. Hill, the physiologist, led to a reversal of many time-honored opinions on ventilation. Eight students were placed in an air-tight chamber of about three cubic metres capacity, in which the movement of air, the degree of humidity, and the temperature could be regulated. Here they were kept until the amount of carbon dioxide present had reached about 4%; at this stage the oxygen in the atmosphere was less than 17%, and the air was of such a composition that it failed to support the combustion of a lighted match. The wet-bulb thermometer showed 83°F., and the dry-bulb thermometer a little more. The men inside the chamber exhibited much distress; their faces were flushed, and their skin and clothes were moist with perspiration. The air within the chamber was then set in motion, and immediate relief was experienced; the pulse dropped from an average of 97 beats to an average of 79, and without any alteration or improvement in the percentage composition of the atmosphere inside the chamber. From a study of the results of such experiments, Mr. H. I. Ireland, in the transactions of the Chemical, Metallurgical and Mining Society of South Africa, summarizes the factors relating to atmospheric conditions, exercise, and rest as follows: (1) Stuffiness is due primarily to stagnation—to warmth, humidity, and stillness. For the purpose of utilizing fully the value of air as a restorative it should be provided with considerable cooling-power; the temperature should be reason-

ably low; the air should be dry and in motion. (2) A carbon dioxide content as high as 1% has no appreciably detrimental effect on a person who is resting; it only causes deeper breathing on the part of those who are engaged in muscular effort. (3) There is no evidence to show that exhaled air contains organic toxins. (4) The metabolism of living is facilitated, waste products are removed more easily, general health is improved, and disease is lessened by living and working in cool dry air that is in motion. With an appreciation of the importance of atmospheric cooling-power as a factor of efficiency, health, and comfort, Dr. Hill invented and dedeveloped the kata-thermometer. Apparently it was used first in Belfast, during an investigation of the conditions under which the operators worked in weaving-sheds and spinning-mills, where the atmosphere was hot and humid. It was then suggested that the instrument should be made to show relative cooling-power, in units of heat per unit of surface per second. This was done.

The kata-thermometer is a spirit-thermometer with a large bulb at the bottom and a small bulb at the top. The glass tube connecting these bulbs is graduated between 100°F. and 95°F., the mean of which is 36.5°C., which may be taken as the average skin-temperature of the human body. Before a reading is possible the instrument is placed in hot water and the spirit is made to rise into the top bulb; it is then dried and placed in the atmosphere of which a measure of the cooling-power is desired; and the time taken for the spirit to drop from the 100°F. mark to the 95°F. mark is noted. The instrument can be used either wet or dry. In the former case the lower bulb is covered with a fine lace glove, in the same manner as a wet-bulb thermometer, and wetted. When dry, it is cooled by convection and radiation; when wet, by convection, radiation, and evaporation. The difference between the two readings gives the measure of cooling by evaporation. The instrument is now constructed of a standard size, and is tested before and after experimental changes of temperature. A factor number is then determined by taking readings in a chamber that is surrounded by a water-jacket. The temperature of the chamber is read, and the cooling-power is noted; then, by means of a formula, a factor is given to the instrument. For example, in the case of a kata-thermometer with a factor of 488, that takes 100 seconds to cool from 100°F. to 95°F., the cooling-power of the surrounding atmosphere is 100 divided into 488, or 4.8 millicalories per square centimetre per second. The area of glass surface of each instrument differs slightly, hence the need for the factor. Therefore, by means of the kata-thermometer, the measurement of the cooling-power of the atmosphere or of air currents can be recorded in precise terms. The value of this device in the investigation of conditions underground is evident. The inventor has pointed out that the human body is a dynamic organ that consumes food, makes physical effort, and produces heat, the excess of which must be dispersed into the atmosphere. The ordinary thermometer is of little value in indicating what the body requires, because the reading gives the temperature of the surrounding atmosphere only, and takes no account of air currents. The dry kata-thermometer shows the influence of air currents; the wet kata-thermometer, that of humidity as well. Absolute humidity is of much greater importance, physiologically, than relative humidity, because the air is warmed to the temperature of the skin and lungs by contact, and is saturated with water-vapor at that temperature. Air that is saturated at 0°C. can hold about 5 grammes of water per cubic metre; if saturated at the temperature of the skin it holds about 45 grammes; so that, physiologically speaking, air is dry even if there be a mist, and under such conditions it has great powers of drying and cooling the skin and of evaporating water from the lungs. If the air is saturated at the temperature of the body it has no power to cool by radiation or by convection; neither can it cool by evaporation, by reason of its condition of water-saturation at that temperature. Under such circumstances there is a danger of heat-stroke. When British soldiers were in Mesopotamia they lived in tents in which the temperature rose as high as 130°F. Many died of heat-stroke because their health was undermined by malaria, or by other complaints, and the sweat-glands refused to function. Death was seen to be inevitable from the moment that sweating ceased. Normal perspiration may be likened to the operation of a wet kata-thermometer: the temperature is reduced by the evaporation of water. The condition of the invalid who cannot perspire may be likened to the operation of the dry kata-thermometer: a hot wind warms it still more.

The importance of such an instrument in estimating the cooling-power of the atmosphere in mines has been shown by investigations in South Africa. There seems little doubt that in the near future the study of hygiene on a scientific basis will have progressed so that the maintenance of a 'kata' cooling-power in the atmosphere, by the regulation of temperature, humidity, and velocity of air, will be recognized as a step toward the attainment of a high efficiency among employees. Dr. Hill is wise in his conclusions. He argues that atmospheric conditions should be such that manual laborers would be glad to work in order to keep themselves warm. A gradation in the cooling-power of the atmosphere, according to occupation, has been mentioned. Dr. Hill suggests the following 'kata' indexes as suitable for different classes of work: Sedentary occupation: dry 'kata', 5 to 7; wet 'kata', 16 to 20. Light manual work: dry 'kata', about 8; wet 'kata', about 25. Heavy manual labor: dry 'kata', about 10; wet 'kata', 30 to 35. Such a scheme would be impracticable in many cases, for workers have to perform varying kinds of manual labor in the same atmosphere. Nevertheless, the statement of an ideal condition is useful, even if the ideal be not attainable; in the present instance, it is obvious that the recognition of the value of a mathematical basis of estimation has drawn attention to fundamental factors of health and contentment that otherwise might have been ignored. Thus we are made to recognize our debt to the scientist, to whose investigations and inventions we owe so much.

Blue Sky Regulations

The Editor:

Sir—I have read with considerable interest your editorial comment in response to a request for a statement in reply to the telegram from the Utah Securities Commissioner who had appealed to the U. S. Attorney General asking that he take action against the California Commissioner of Corporations for his violation of the Sherman Anti-Trust Act for endeavoring to prevent the sale of Bingham-Galena mining stock in California. I note you say "he has full power to refuse the sale of stock in California and that to hold that every Blue Sky Law is null and void with respect to supervising the sale of issues is a position too puerile and foolish for consideration".

As a constant reader of your paper, I am surprised to see such a statement coming from the Editor. I wonder if he ever thought that the various States of the Union get their powers from the Constitution of the United States, and if he ever took time to read it he would find that no State in the Union, California included, has a right to abrogate the right of contract or grant any privileges or immunities to citizens in the several States (such as brokers or licensees under the Blue Sky law). For your information I will quote Art. 1, Sec. 10, of the Constitution of the United States: "No State shall pass any bill of attainder; *ex post facto* law; or law impairing the obligation of contract"; Art. 4, Sec. 2: "The citizens of each State shall be entitled to all the privileges and immunities of the citizens in the several States"; Art. 6, Sec. 2; "The Constitution and the laws of the United States which shall be made in pursuance thereof,—shall be the supreme law of the land and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding."

Again in Art. 4, Sec. 3: "The Senators and Representatives—the members of the several State legislatures, and all executive and judicial officers of both the United States and of the several States shall be bound by oath or affirmation to support the Constitution". It is evident the founders of our Government, with commendable foresight, were able to apprehend and forestall the imminent dangers from the possible abuse of legislative powers, erecting impregnable barriers by putting into the Constitution certain basic laws, with provision that neither the Congress nor State legislatures shall have the power to contravene, repeal, or abridge them. The Constitution thus established a boundary line between the unstable legislative privileges possible to a corporation, and the inalienable rights of individuals under the law. Just the thing the Utah Commissioner is trying to defend for which he is to be highly commended.

Therefore, it is self-evident that the Utah State Commissioner was absolutely right in stating that the State of California had no right to deny a right granted by the State of Utah; and if it were carried before the U. S. Supreme Court it would be proven that every Blue Sky law is unconstitutional and therefore null and void because it does impair the obligations of contract. Then why try to defend this Blue Sky law bunk, which is so damaging to the mining industry?

Roy M. Harrop.

Omaha, August 19.

[Our correspondent is in error; the statement he quotes was not made by us but by Mr. E. C. Bellows, the Californian Commissioner of Corporations. We feel sure that Mr. Harrop's criticism will be seen by Mr. Bellows in due course. As to the constitutionality of the law, we note that an opinion was handed down by the State Supreme Court on August 25, upholding the Corporate Securities Act, through which the Commissioner derives his authority.—Editor.]

Russian Placer Mining

The Editor:

Sir—In the issues of your paper for March 19 and 26, and April 2 of the present year, Mr. Leon Perret attacks well-established methods of winning alluvial gold. While he quite pointedly refers to the lamentable failures of foreign engineers (myself included) in the domain formerly comprised in the Russian empire, his strictures appear to include a general criticism of gravel-mining methods in all countries outside Russia.

The laudation of Russian mining methods by Mr. Perret covers a lateral range of territory hardly to be equalled in any other country, from 60° to 140° east longitude, and a scope of operations ranging from prospecting to gold-dredging and drift-mining. Incidentally he makes arrow-like thrusts at his foreign contemporaries, who are, it is to be presumed, expected to answer his sallies in detail or otherwise to take defeat by default.

Perhaps the best comment one can make regarding the former operations of the Lenskoie Gold Mining Co. in the Vitim district of Siberia is to quote (substituting figures in U. S. currency) the costs of drifting operations from the ninth annual report of the Lena Goldfields, Ltd.,

which formerly held a large block of shares in the Russian concern. In this table the cost of drift-mining in 1913-14 is compared with the same in the two following years, when the modifications of practice introduced by the "American engineers" had begun to affect the results.

Dealing with	1913-14 787,450 cu. yd. Per cu. yd.	1914-15 913,795 cu. yd. Per cu. yd.	1915-16 753,240 cu. yd. Per cu. yd.
Mining	$2.70	$1.98	$1.52
Tramming	0.43	0.26	0.16
Washing	0.30	0.24	0.26
Development	0.26	0.82	0.33
Construction	...	...	0.10
Mine administration	1.06	0.70	0.94
Prospecting	0.06	0.27	0.02
Bullion realization	0.12	0.12	0.02
Total working cost	$4.93	$4.39	$3.35

This shows a saving on the items mentioned of well over $1,000,000, comparing the first and last seasons quoted on the average quantity of gravel dealt with. The above items relate to ordinary mining operations which came to a certain extent under the control of Messrs. Purington and Smith. They do not include head-office charges, agencies, depreciation, losses on store-keeping and steamboat operation, war levies, excess-profit taxes, and general amortization.

For the four years during which I was concerned with the technical operations of the Lenskoie company, the cost of mining, tramming, and washing showed the following changes:

	1912-13	1913-14	1914-15	1915-16
Mining	$2.42	$2.70	$1.98	$1.52
Tramming	0.50	0.43	0.27	0.16
Washing	0.39	0.30	0.24	0.26
Total	$3.31	$3.43	$2.49	$1.94

Contributing factors to the diminution of cost were the reduction of man and horse labor, especially in tramming gravel; the successful application of winter-washing methods, by which all gravel was washed as mined throughout the year; a more systematic and economical laying out of the drifting-blocks in development; and a considerable amount of recovery of the heavy timbers employed, so that they could be used again.

Many of the desirable features above outlined were suggested by Mr. Perret in 1913, and discussed between him and me. The departure of Mr. Perret from the property in 1914 deprived those left in charge of the benefit of his supervision, and the suggestions made by him as well as the plans he initiated naturally underwent considerable modification later.

In regard to the long sluices which were erected in 1914 and following years, and which Mr. Perret so severely criticizes, it is worth while quoting the following unsolicited testimonial from the annual report (in Russian) of the Lenskoie Gold Mining Co., submitted to the annual meeting of shareholders at Petrograd on September 30, 1915:

"The improvement of washing appliances, that is, the gradual transition from trommel machines and *kulibinas* to long American sluices of Alaskan type has given an important reduction in the loss of gold in washing processes, and at the same time has contributed to the lowering of the washing cost. Thus (converting Russian into U. S. figures) in 1912-13, 830,000 cubic yards cost 56 cents per cubic yard to wash, say $465,000, while in 1913-14, 873,000 cubic yards cost only 35 cents per cubic yard, or $306,000, a saving of over 36%."

The Lenskoie accountant in the above figures has added certain items to washing cost which I have always considered as belonging to tramming, but this fact does not affect the value of the comparison.

The result of winter washing during four years is summarized below:

	1913-14	1914-15	1915-16	1916-17
Year's output of gravel washed, cu. yd.	873,635	974,234	788,942	569,679
Winter washed, cu. yd.	Experimental	242,420	287,280	299,570
Percentage washed in winter	..	25	36½	52½

For the winter of 1916-17 nearly 80% of the gravel actually mined was washed at once; and, as shown above, taking the entire season's output, more gravel was washed in the winter than in the open season.

Trommel washing-plants such as Mr. Perret eulogizes are used at drift mines in Australia, California, and Alaska, where conditions warrant the use of same. Such a plant is in fact depicted and described by me in Bulletin No. 263 of the U. S. Geological Survey, pages 78-81, as having been inspected by me at the mouth of Bear creek in 1904. It was said to have a capacity of 800 cu. yd. in 24 hours, was not particularly economical, and was soon afterward discarded.

The main reason for superseding trommel machines at Lenskoie by sluices was one that Mr. Perret appears to have entirely overlooked, namely, the desire to take advantage wherever possible of the transporting power of water, of which there was abundant supply, in the distribution of the tailing. A second objection to the trommel was its inadaptability to winter washing, at temperatures of from 40° to 60°F. below zero.

The marked increase in yardage treated from drifting operations, as well as in the gold recovered, comparing the seasons of 1913-14 and 1914-15, is of interest, and, to say the least, it is a curious coincidence that these increases should have occurred simultaneously with the development of the methods introduced by the foreign engineers.

	1913-14	1914-15
Yardage treated	873,635	914,029 (drifting only)
Total drifting output	$6,150,000	$8,600,000
Recovery per cu. yd.	$7.92	$9.40

One thing should be remarked in this connection: it is certain that much of the gold stealing, which when I first went to the property was estimated to amount to over $1,500,000 annually, was done away with by the elimination of the winter dumps, and of the old methods by which the miners and surface-men were enabled to handle the rich gravel many times in its progress from the face to the tailing-piles.

As regards the Russian miner, for whom Mr. Perret is so enthusiastic an apologist, the following comparison shows as nearly as possible the work performed in the Lenskoie district in 1915. The Californian example cited is the old Red Point drift mine, the data being supplied to me by Ross B. Hoffman who collected them in 1892.

The two Lenskoie examples, are first, that of the Lenskoie company's work, in which the laborers appear to have had a low efficiency partly owing to that exaggerated paternalism of the Russian mining law, so fully described by Mr. Perret. The second example is taken from data collected by me in my inspection of a tributers' drift mine on the Nigri river, where the Russian laborer had, so to speak, to look out for himself. In this second case the duty of the man at the face was equivalent to that of the American drift miner in California.

	Lenskoie	Tributers	Red Point
Duty in cu. yd. per shift:			
Per man employed at the face	1.4	2.3	2.3
Per man employed in all departments	0.45	0.85	1.5

I have had little experience with Russian laborers, but in general find them better suited to agricultural than to mining pursuits. At the mines of the Orsk Goldfields on the Pacific coast of Siberia, Chinese and Koreans were used almost exclusively and were very satisfactory.

It would seem that cost data and figures of output such as those above given, and mainly quoted from published reports, are the best answer to the numerous criticisms of Mr. Perret. To describe again the technical methods installed at Lenskoie or other places in Siberia would be but repetition, as I have already been at some pains to describe these together with the results attained, and reference may be made to the technical press in which the articles were printed.

As regards further points in Mr. Perret's articles, it seems that he has been quite effectively answered by your other correspondents, and it would not appear that any useful purpose can be served by further prolonging an academic discussion which relates to past and forgotten incidents.

C. W. PURINGTON.

London, June 27.

Indexing Current Technical Literature

The Editor:

Sir—From your thorough analysis of this subject in your issue of August 6 it would appear that there is no regular or complete publication which is devoted entirely to the indexing of current literature on mining, metallurgy, and allied topics, and I believe that your diagnosis is correct. The weakness of 'The Engineering Index' and 'Chemical Abstracts', in respect of their value to the mining profession, is that they cover every branch of engineering. Moreover, the present arrangement of this index, started in 1919, scatters mining topics throughout a volume of nearly 600 pages, and even then it is not complete. Formerly this matter was concentrated under 'Mining and Metallurgy'. While 'Chemical Abstracts' is excellently done, and is issued twice a month, it does not record all of the published matter relating to mining. Its 800-page annual, which is simply an author, subject, and formula index, is somewhat awkward, as each item has a number, and one must have the whole year's abstracts (24 of them) beside one to find any particular reference, although the annual index does give a line or two on the matter.* Having disposed of these three excellent yet unsatisfactory indexes, what has the mining man got for ready reference devoted exclusively to his profession? Apparently very little. The indexes of recent papers prepared by the I. M. & M. and A. I. M. & M. E. are also deficient—one in scope, the other in form. Without doubt, the best international bibliography—for such any new index must be—of mining and metallurgy was the 'Mining World' index, published twice a year from 1912 to 1916, inclusive. When it was absorbed by the 'Engineering and Mining Journal' its usefulness came to an end. Abstracts were made from 400 publications, 190 of which were foreign. (The 'Engineering Index' covers 325 domestic and 325 foreign papers; 'Industrial Arts', 150 in all; and the A. I. M. & M. E. a total of 1300 journals, this last figure being your own.) The 'Mining World' system was that of alphabetical listing, with a brief synopsis of the article, under 19 different heads and 'Miscellaneous', the latter coming at the end of each main head. Then there was an author's index and a subject index. The U. S. Geological Survey list of publications, of 187 pages, has a similar arrangement. The whole was extremely simple, complete, and reliable, and cost $1.50 per half-yearly volume.

Several questions now arise: how many mining and metallurgical engineers want such a reference? What would be the cost of a regular monthly and half-yearly index? Where is a library in which this work could be done? Who would do the abstracting? How would the abstractors be recompensed and what would be the subscription?

It would seem that private enterprise could not make such a bibliography thorough and yet profitable, therefore some technical journal or society must do it, and as the two leading mining journals are not inclined in that direction, it looks as if the national mining-engineering society—the A. I. M. & M. E.—was the logical one to undertake the work, already having the foundation laid for such a publication. It has access to the great technical library in the Engineering Societies building in New York, and is in a position to ascertain the demand, cost, and price. In addition to a half-yearly index, monthly supplementary lists could be distributed, as is done by the Geological Survey. Such matter could be mimeographed, and mailed promptly. A 6 by 9-inch page is most suitable for the bound volume. This matter of prompt publication is of great importance, because, if an engineer learns of an article, and yet cannot get a copy of the particular technical journal, he now can write to that publication, or the United Engineering Societies library, and procure a photostat of the complete article at a cost of only 25 cents per page.

As you say, abstracting is no mechanical operation; it

*The Industrial Arts Index, published monthly, half-yearly, and annually, in New York, is a cumulative index to engineering, trade, and business periodicals, but is also unsuitable, in that it is too general, and mining is scattered through over 600 pages.

requires engineering and editorial ability and great patience. I have done a good deal of this work myself, and know what is required, and believe that a resuscitation of the 'Mining World' index would be a good idea.

This brings me to an allied topic, that of special bibliographies. The value of any bibliography lies not only in articles having titles that indicate the topic, but also in those on any subject to which the particular reference is made. For instance, suppose that a bibliography on 'Explosives' is being prepared, and the bibliographer sees an article entitled 'Quarrying Marble in California'; many might pass that by, but a trained man would scan the text for any mention of blasting, which would then be noted. Therein lies the skill of the abstractor. During the preparation of a bibliography on sampling, not yet published (some of the references go back 30 years, but most of them cover the last 10 years to mid-1921, and it is a fairly complete record), it was very noticeable that in otherwise well-written articles, unless they were directly on sampling, this important matter was either entirely omitted or received only a line or two. In describing a mine, mill, or smelter, the method of sampling appear to be taken as a matter of fact, therefore little space is devoted to them. I should think that every engineer who describes a mine or works should say how the sampling was done. For instance, in your issue of July 23, Mr. J. N. Nevius discusses 'Resuscitation of the Octave Gold Mine', but not a word is said on the method of sampling, which must have been unusual. Again, in the issue of July 30, your Mr. A. B. Parsons describes the Engels copper mine, but he omitted to state how the mine is sampled; although in the August 8 number he did cover sampling in the mill and show in the flow-sheets where it was done.

I have digressed from indexing to sampling, but such is the trend of one's thoughts when concentrated on a particular subject.

M. W. von Bernewitz.

Washington, D. C., August 11.

Stocks and Prices

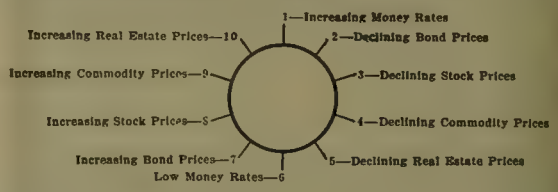
The Editor:

Sir—I was much interested in your editorial comment of July 9 on R. H. Tingley's article in the 'Annalist' on the present worth of stocks and bonds, but your question as to "whether stocks will appreciate in price in proportion to a further fall in commodity prices, or is connection between the two so unstable that a rise or fall in the price of both, at one and the same time is possible" seems to me somewhat confusing.

Stocks, with possibly a few exceptions, have not appreciated in price with the fall in commodity prices, or are they likely to do so on a further fall, until the time comes when thoughtful speculators consider that the reduced price will stimulate buying of the product at a profit to the producer.

Stable commodity prices, when they have existed for a sufficient length of time to allow the industry to be thoroughly adjusted to the new conditions, are more likely to induce higher stock prices, as during this period stocks have passed from weak to strong hands, and taken out of the market; thus creating a scarcity of stocks when the business revival comes.

The rise and fall of stocks, bonds, and commodity prices are phases of the business cycle, which have been indicated graphically in 'Business Barometers' by Roger W. Babson as follows:



Douglas Waterman.

Havana, Cuba, July 25.

Indexing Current Technical Literature

The Editor:

Sir—In your editorial of August 6, entitled 'Indexing Current Technical Literature', you say much that is pertinent.

It is pleasant to read your remarks in praise of the excellent work of the American Chemical Society. Many of your readers are doubtless, like myself, grateful for the glimpse you give of the organized team-work that lies behind the Society's achievements. There is, however, one notable bibliography in the mining field that you have not mentioned: I refer to the series of substantially-bound annual bulletins of the U. S. Bureau of Mines entitled 'Bibliography of Petroleum and Allied Substances'.

For your information and comment I enclose a copy of one of these volumes and also an example of the abstracts by which they are at all times kept up to date by their editor, Miss E. H. Burroughs.

Alexander Anderson.

Fullerton, California, August 16.

Revision of Mining Law

The Editor:

Sir—I have done quite a lot of prospecting in the desert where government stakes are scarcer than even water, and water may cost in time and labor from 50c. to $1 per gallon.

If the sponsors of the proposed new law will mount a mule at Goldfield, Nevada, ride to Las Vegas, Utah, then to Daggett, then to Darwin and Keeler, in Inyo county, California, a region rich in mineral propects, I doubt if they would find one survey stake to tie to.

The proposed law would drive the prospector out of this and all districts like it.

I see no very serious faults with the present law.

Frederick Spear.

Lone Pine, California, August 30.

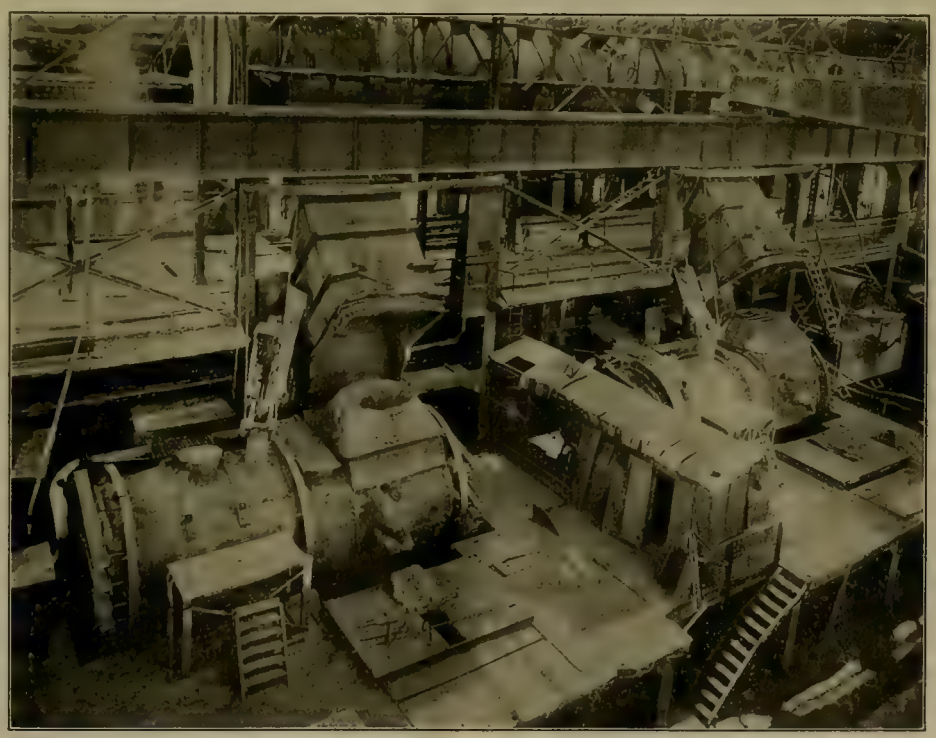
Nevada Consolidated Copper Company—V

The Smelter

By Arthur B. Parsons

The smelting of copper ore and concentrate is more thoroughly standardized than many metallurgical operations. Most modern copper-smelting plants are alike; they consist of mechanical multiple-hearth roasters, reverberatory matting-furnaces, and converters, together with the appropriate buildings to house them; and such essential adjuncts as power-plants, transportation systems, flues, and stacks. If the plant is old enough, there is likely to be a blast-furnace department; the probability is that it has been idle for some years and, moreover, that the furnaces will never run again, although for some strange reason many metallurgists are loath to see these old friends torn down. In spite of this similarity in the important features of copper-smelting plants, and the uniformity of practice in accord with generally accepted principles, there are details of construction and of operating methods, used in individual plants, that are of interest. I shall endeavor to point out a few of these features in describing the smelter of the Nevada Consolidated company at McGill, which, I may say incidentally, conforms to fashion even to the extent of preserving its unused blast-furnace department.

First, however, for the benefit of the 'semi-technical' reader or the young engineer, whose facts and ideas may need sorting and indexing, a few paragraphs will be devoted to a concise description of the three processes involved in the smelting of sulphide copper ores or concentrates.



PIERCE-SMITH CONVERTERS AT THE STEPTOE SMELTER AT M'GILL, NEVADA

The purpose of roasting is to 'burn-off' sulphur by heating the pulverized ore in the presence of an excess of air. Besides converting part of the copper sulphide to oxide, the iron is oxidized, and volatile impurities such as arsenic and antimony are removed. The temperature varies from 450 to 650°C. and no fusion or even sintering takes place. Roasting was formerly done in a long coal-fired brick furnace with a single hearth, on

which the ore was stirred and pushed to the discharge end by hand-rabbles. The modern type of roaster consists of a series of superimposed circular hearths, onto the uppermost of which the ore is fed; either the hearths or the rabbles revolve, thereby stirring the charge mechanically. The ore passes successively over the lower hearths. The advantages of such a roaster are economy of space, fuel, and labor, and uniform roasting. The product is called calcine.

In the reverberatory furnace the calcine, mixed with the requisite amount of flux, generally crushed limestone, or an ore high in lime, is fused; the sulphur remaining in the calcine acts as a reducing agent and combines to form a copper-iron matte containing 35 to 40% copper; while the silica, lime, and iron, with some alumina, form a silicious slag that goes to waste. The reverberatory is a shallow brick furnace approximately 130 by 20 ft. in plan with a concave hearth and an arched roof of silica brick that reflects or 'reverberates' the heat onto the charge. It is fired from one end with coal or fuel-oil; the height of the smelting-chamber is diminished at the opposite or stack end.

Molten matte is tapped from the reverberatory and taken to the converters. The treatment in the converter consists of two parts: first, the shell is filled to the tuyere-level with matte; silicious ore is added as flux to combine with the iron in the matte, thus forming a slag which is tapped-off to leave 'white' metal or copper sulphide; further additions are made until the shell contains a full charge of white metal. The copper is then 'blown'; that is, air is forced through the bath, decomposing it at 1150°C. into practically pure copper and sulphur dioxide gas, which escapes. The modern converter is a huge cylindrical steel shell, lined with neutral refractory brick, and mounted on a horizontal axis on which it can be revolved. On the top is the throat through which matte and ore are charged; there is a row of tuyeres along the back, and tap-holes for the removal of slag and blister copper are provided in front. This is known as a 'basic' converter in contrast to the old 'acid' converter, in which the lining of silicious material supplied the flux for the iron in the matte, and was gradually eaten away.

The general arrangement of the plant at McGill is peculiar. The group of smelter buildings is situated about three-quarters of a mile north of the concentrator, which supplies practically all of the material for smelting. Moreover, the main smelter buildings themselves are scattered over the hillside with several hundred yards intervening, thereby requiring excessive haulage, a feature that is particularly objectionable because hot materials like matte, calcine, and slag are to be transported. Another unusual feature is the erection of three separate stacks, one for each department; the roaster stack is 250 ft. high and 18 ft. inside diameter; the reverberatories are served by a 300-ft. stack, 22 ft. in diameter at the base; and the converter stack is 90 ft. high and 10 ft. in diameter. Mr. Lakenan, general manager for the company, informs me that the erection of a single stack was debated at the time the plant was erected, and that the decision to build three individual stacks was based on the assumption that probably two years would elapse before the maximum capacity of the plant would be attained. During that period, low stack-temperatures and insufficient draft would have tended to make operations less efficient and less economical. If the company were to build a new smelter in the light of its present knowledge as to the extent of the ore-reserves at Ruth, and as to the performance of the concentrator, the various buildings would doubtless be arranged compactly and a single central stack would be provided.

The problem of haulage is nicely solved by a complete system of standard-gauge tracks connecting the concentrator, the various smelting buildings proper, and the other departments, which include:

Coal-dust plant
Power-house
Warehouse
Boiler-shop
Machine-shop
Foundry
Blacksmith-shop
Carpenter-shop
Tin-shop
Magnesite-brick plant

For intra-plant service, small steam-locomotives of Porter or American manufacture, with saddle-tanks and an over-all clearance of only 7 ft., are used. These have a weight of 17 tons on the drivers, and are fired with either coal or fuel-oil.

The introduction of flotation, and the consequent necessity for smelting a considerable amount of fine-slime concentrate containing less pyrite, more silica and alumina, and more moisture than that contained in the concentrate from the Wilfley tables and vanners, has been responsible for sundry changes in smelting practice.

The following average analyses illustrate the difference in the concentrate to be treated. (A) represents the concentrate smelted in 1916, and (B) that in 1919.

	Copper	Silica	Iron	Alumina	Sulphur	Moisture
	%	%	%	%	%	%
A	8.00	28.4	23.9	6.8	27.8	10.28
B	8.49	30.7	19.8	9.9	23.9	17.2

The concentrate (B) is a mixture of table concentrate, having a composition similar to that of (A), and flotation concentrate in which, obviously, the sulphur and iron must have been still lower and the kaolin constituents still higher than shown in the analysis of (B).

Although an increased proportion of flotation concentrate was produced in 1920, the character of the mixture changed somewhat, as may be seen from the analysis given at the conclusion of the discussion of 'roasting'. The physical condition of the flotation concentrate is also important. Not only are the particles exceptionally fine, 85% passing through 100-mesh and 60% through 200-mesh, but after dewatering in vacuum filters the concentrate acquires the consistence—characteristic of all filter-cake of fine flotation products—which can best be compared with that of tooth-paste squeezed out of a tube

in cold weather. The problem of successfully treating a mixture consisting in part of a filter-cake such as just described presented itself in 1917, at which time the McDougall roasters were altered for the purpose of meeting the new requirements.

ROASTING. The end in view in making the changes was to effect a complete disintegration of the caked material and a thorough mixing with the granular concentrate before it reaches the temperature of actual roasting. Intimate admixture would make the sulphur in the more pyritic portion available as a fuel for assisting the roast of that portion of the material less rich in sulphur. R. E. H. Pomeroy, then smelter superintendent, and J. C. Kinnear, who recently succeeded Pomeroy, and who was at that time his assistant, originated the scheme for altering the furnaces, and they later collaborated in preparing a paper describing the results of their work. This paper was read before the Nevada Section of the A. I. M. & M. E.; many of the details of the following description of the modifications made in the furnace are taken in condensed form from this paper, as there have been no substantial changes in the practice since that time except the substitution of pulverized-coal burners to take the place of the fire-boxes for burning ordinary coal, that were built in 1917. It was found that the comparatively low sulphur content, and the large proportion of moisture that must be evaporated, necessitated some fuel other than the contained sulphur. The most efficient place to apply the extraneous heat was found to be the fifth hearth, that is, the fifth from the top, at which point the flame from the present pulverized-coal burners impinges. Most of the roasting takes place on the fifth or six hearth, depending upon the character of the feed.

The McDougall furnaces originally installed had six hearths, 18 ft. in diameter, and were water-cooled. The alterations were as follows:

(1) Air-cooling was substituted for water-cooling. The air, under a pressure of 2.9 in. of water, passes up through the centre column and out through the arms. It is discharged through holes in the bottom of the arms between the rabble-heads. This air jet, impinging directly upon the turning bed of calcine, serves the double purpose of cooling the arms and centre column and of directing the heated air upon the hot calcine. The velocity is not sufficiently high to cause excessive dusting. This air is supplied by two fans made by the National Blower Co.; the fan wheels are 84 in. diam., the vanes are 42 in .wide; they are driven at a speed of 360 r.p.m., by 100-hp. motors. The delivery, as measured by Pitot-tube readings, is 113,000 cu. ft. of free air per minute. This approximates 4700 cu. ft. of air per furnace per minute. Distributing headers of ample cross-section have been provided with blast-gates at each fan and at each furnace. Each centre column is provided with a wind-box or bustle-pipe equipped with a stuffing-box to prevent leakage of air.

(2) Owing to the higher moisture and lower sulphur content of the mixed feed since the development of the flotation process it has been found necessary to increase the period of roasting and drying. The furnace shell was extended upward 4 ft. 7 in. and the number of hearths increased from six to eight by the additoin of one working chamber and the utilization of the top or roof of this new chamber as a drying-hearth open to the atmosphere. The feed is dropped from the feed-hopper upon the periphery of the drying-hearth.

(3) The addition of this eighth hearth resulted in the convenience of allowing the effluent gases to pass to the flue through a gas outlet situated at the centre of the furnace around the top of the centre column. This feature permits a symmetrical distribution of the heat passing under the drying-hearth, and produces an efficient drying-surface for the wet feed.

(4) It was determined by experiment that the most suitable mechanism for handling large proportions of flotation concentrate on the drying-hearth was a set of revolving disc-harrows like those commonly used in farming. The action of these discs is to cut up the masses of caked concentrate as fed upon the hearth, turning, rolling, and coating them with the coarser sulphide particles, thus preventing further agglomeration. The idea was suggested by the method of the baker dusting his sticky dough with dry flour to prevent its adhesion to hands and utensils. A further advantage of this disc arrangement, over the scraper-plow commonly used, is the fact that the material is completely turned down to, and in contact with, the drying surface at each pass, thereby exposing new surfaces to the drying-hearth and to the atmosphere. In contrast with this, the wear on the bottom of the usual scraper-plow allows an ever increasing protecting layer of dried material to accumulate between the drying surface and the fresh concentrates. The idea of 'flouring' the chopped cake gives a key to one important reason for the decision to precede flotation with concentration on roughing-tables as outlined in the previous article describing the concentrating plant. One unit has been remodeled to provide for the fine grinding of the entire mill-feed, followed by flotation and tabling of the flotation tail; in the most recent unit, however, a table concentrate is made preliminary to fine grinding. A considerable quantity of granular concentrate is thereby obtained, and it is this material that the smelter metallurgists particularly desire. This brings out an interesting point: the advantage to the enterprise of having unified control over all operations. Each branch of the work is conducted with due consideration for the requirements of the other departments; the end in view being to obtain the maximum net profit.

(5) Much trouble was experienced with the old line-shaft drive with a friction-clutch and belt at each furnace. This drive has been entirely replaced by individual 10-hp. motors, direct-connected to the driving-gear through enclosed spur-gear speed-reducers running in oil. The gearing has been let down about three feet to remove the motor and gearing further from the hot under-surface of the lower hearth. The speed of the centre column was increased and the column now makes

one complete revolution in 34 seconds as compared with 38 to 55 sec. formerly.

(6) In keeping with modern ideas of furnace construction, the floor-arches of common brick have been replaced by fire-brick tile of large dimensions and specially shaped to form the required circular arch. The area of the central drop-hole has been maintained at 23.2 sq. ft., which has proved satisfactory.

(7) Provision has been made to feed the lime-rock required as flux in the reverberatories into the roaster, where it is dried, heated, and intimately mixed with the calcine. The mechanical lime-rock feeders have been so situated as to feed onto the seventh hearth, which is the one next the bottom. The hoppers above the feeders have been made triangular in shape in order to give the maximum storage capacity, each hopper serving two adjacent furnaces. The lime-rock is a locally quarried stone of good quality crushed to ¾-in. size; the proportion of limestone to concentrate is approximately 8.4%.

One recent change that should be mentioned is the substitution of an improved feeder for the balanced-plunger feeder designed at the time the changes just outlined were made. The plunger feeders did not work efficiently even when 60% of the concentrate was from the gravity units in the mill. The new device is of a pan-conveyer type consisting of a series of drags with sprockets and chains. The thickness of the exuding 'ribbon' of concentrate is regulated by a rack-and-pinion gate built above the conveyor and in the front of the small storage-bin.

There are 24 roasting-furnaces. The mill-concentrates are hauled to them in 10-ton hopper-bottom cars, and the calcine is hauled to the reverberatory storage-bins in 8-ton cars. The following data are averages covering the operations for the last 6 months of 1920.

Concentrate roasted per furnace-day, tons	55.9
Lime-rock per furnace-day, tons	4.7
Total feed per furnace-day, tons	60.6
Sulphur eliminated per furnace-day, tons	11.7
Water eliminated per furnace-day, tons	7.9
Calcine produced per furnace-day, tons	50.78
Sulphur eliminated, %	79.5
Pulverized coal used per furnace-day, tons	0.28
Pulverzed coal used per ton roasted, lb	10.2
Pulverized coal used per ton of water evaporated, lb	72.1

Analysis of Roaster Feed

Copper	Silica	Iron	Alumina	Sulphur	Moisture
%	%	%	%	%	%
8.04	29.0	23.3	7.5	26.3	12.3

REVERBERATORY SMELTING. The reverberatory plant originally comprised five matting-furnaces built according to the Anaconda design, four of them being 121 ft. long by 19 ft. 6 in. wide, inside dimensions; the fifth, 130 ft. long by 19 ft. 6 in. wide, with a capacity of about 625 tons total charge per day. One of these has been replaced by a new furnace which will be mentioned later. Pulverized coal, used as a fuel, is furnished to the plant by the Holbeck system, a description of which is embodied in the portion of this article covering the coal-pulverizing plant. Pulverized coal has been found to be entirely satisfactory in every respect and has at all times been as dependable as fuel-oil.

Until the middle of 1920 the reverberatories were of the old centre-drop type, fettled or clayed through side doors arranged along the entire length of the furnace. The greatest corrosion of the sides took place along the 50 ft. nearest the charging and firing end; particularly careful fettling at this point was necessary. One-half of the furnace was fettled every 8 hours; the remainder, once every 24 hours. This work required a force of 35 to 40 men daily. Side charging had never been attempted at this plant for several reasons. The width of the furnaces, as originally built, and the position of the charge-floor, running transversely across the furnaces at the firing-end, and extending only 16 ft. toward the opposite end, necessitated either the use of screw- or drag-conveyors, or a prohibitive rearrangement of the tracks. To overcome this difficulty, long charge-bins were hung from the charge-floor, extending over the furnace for 50 ft. from the firing-end. Advantage is taken of the fact that calcine when hot will flow like water to the extreme end of the long charge-bins. From these bins the calcine is fed through a series of pipes inserted through the roof and along both sides of the furnace over the whole of the 50-ft. section. The result is the filling of both lower corners of the furnace (looked at in cross-section) with calcine, thereby completely protecting the sides, and forming a trough-shaped space for the molten charge. Whether the operation is called fettling or charging is immaterial; both are effectually accomplished.

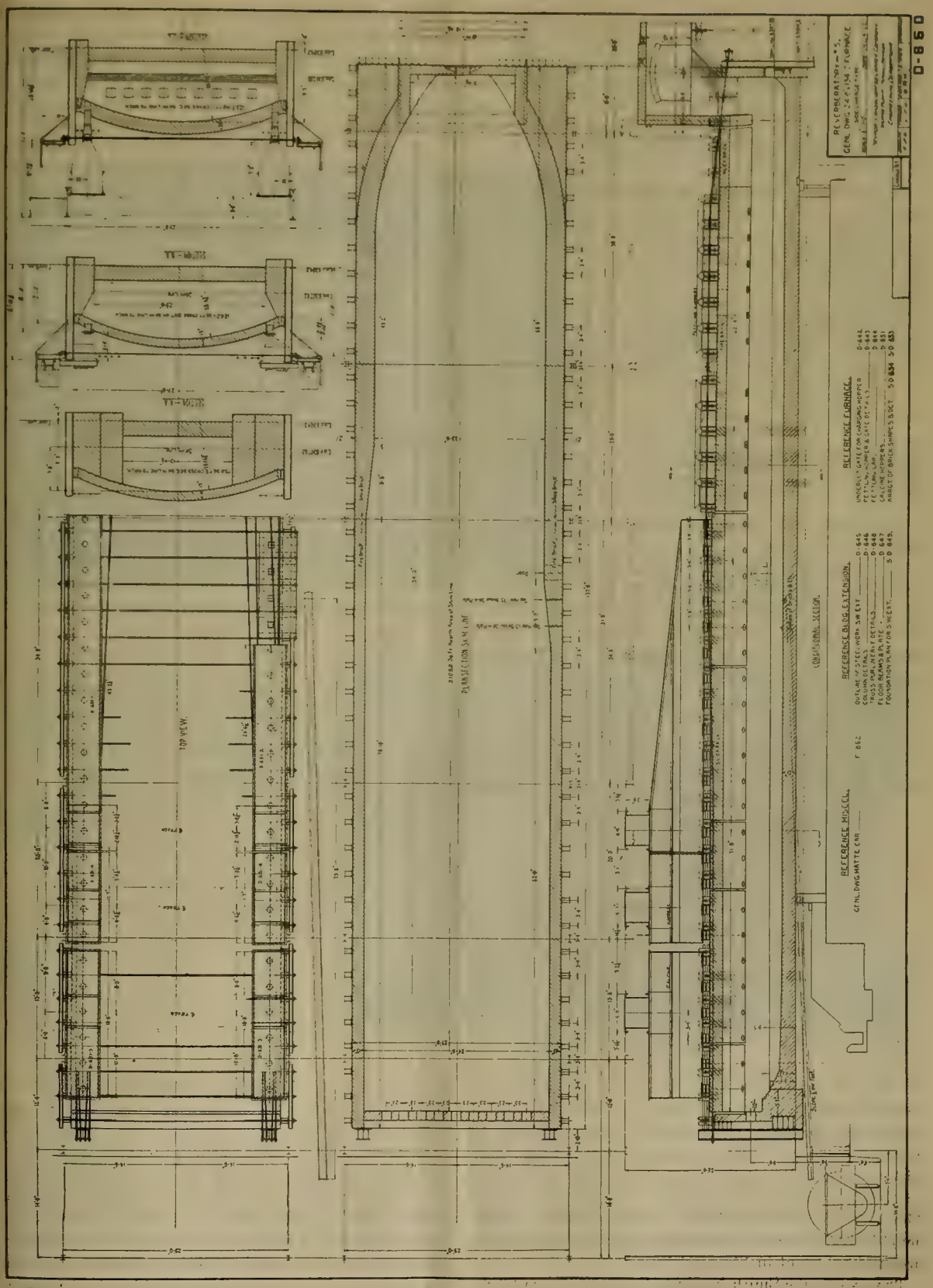
For some distance beyond the 50-ft. point, concentrate and miscellaneous products are introduced as fettling in the usual way, but this is a comparatively light task. The force of men engaged in this work has been reduced from 35 to 10. Two furnaces have been operated along the above lines and have proved in every way satisfactory. The new furnace recently completed is 134 ft. long and 24 ft. wide, with a hearth-area at the skim-line of about 3000 sq .ft. This furnace is provided with mechanical charging and fettling equipment the details being shown in the accompanying drawing. In its design, for which Mr. Kinnear is responsible, are incorporated the latest and best ideas of reverberatory construction.

Two waste-heat boilers are placed parallel with each other in the exit flues, the steam thereby generated being used to supplement the boilers in the main power-plant. Two reverberatory slag analyses are shown below. 'A' represents slag made in 1915, whereas 'B' is typical of the practice in 1920. The change in character of the concentrate smelted is thereby reflected.

	Copper	Silica	Iron	Lime	Alumina
	%	%	%	%	%
A	0.345	42.6	36.3	10.3	6.5
B	0.40	40.0	29.7	5.5	11.1

The slag is granulated by being run directly into a stream of discarded mill-water by which it is carried to the dump.

The flue-dust from the roasters is re-smelted directly in the reverberatories, except for the portion that collects in the segment of the flues nearest the stack; this contains a large proportion of soluble copper and is accordingly leached with water in a concrete launder. The liquor is decanted in settling-tanks, and passed over iron


REFERENCE FURNACE
REFERENCE BLDG. EXTENSION
REFERENCE MISCEL.
TOP VIEW
SECTION
LONGITUDINAL SECTION

for the precipitation of the copper. The precipitate is used for fettling; the residue is temporarily discarded.

The following statistics summarize the operations for the last six months of 1920:

Average grade of matte, copper, %	39.8

	Total charge	Solid charge
Charge per 100 sq. ft. of hearth-area, tons	25.6	23.5
Gross coal, on the charge, %	17.6	19.1
Net coal, on the charge, %	13.2	14.3

The average proportions of materials in the charge were:

Material	%
Calcine and flue-dust	77.3
Cold secondaries from converters	5.5
Hot converter-slag	8.3
Lime-rock	6.9
Fettling	2.0

The following are typical analyses:

	Moisture	Copper	Silica	Iron	Lime	Alumina	Sulphur	Magnesia
	%	%	%	%	%	%	%	%
Calcine	..	8.85	31.9	25.6	..	8.2	5.9	...
Converter secondaries	..	28.37	16.8	28.5	1.4	5.8	9.5	...
Converter slag	..	1.68	25.7	48.3	0.25	5.0	0.93	0.59
Lime-rock	..	...	1.5	0.3	49.3	0.4	..	3.3
Fettling	25.8	3.35	45.8	5.4	..	20.9	5.3	...

The fettling material consists principally of low-grade flotation concentrate.

Converting Practice. Matte from the reverberatories under usual conditions contains 38 to 45% copper; it is tapped into a transfer-car improvised from an old converter-shell mounted on a standard railway-truck with a trunnion at each end to permit dumping. The pot itself is lined with fire-brick and has a roof of silica brick nine inches thick. The inside dimensions are 7 ft. diam. and 10 ft. long. At each of the reverberatory furnaces a pulverized-coal firing-station is provided, and as well as at each converter. It is accordingly possible to apply extraneous heat to the matte and to the car itself at all times except during the intervals of actual travel between the reverberatories and converters. The cars have a capacity of 35 tons of matte when newly lined, at the end of a period of six months, when they are re-lined, they hold from 15 to 20 tons.

These pots allow rapid charging of the converters, both for the initial bath, and for the intermediate chargings later in the cycle. Converter requirements for matte are always anticipated, the matte-pot being filled and held ready under fire on the converter charge-floor. Actual time-records show that a converter can be given its initial bath in about one hour. This compares favorably with the time for the same operation when accomplished by the use of cranes and ladles where converters and reverberatories are under one roof.

As originally built there were four converter-stands to accommodate shells 126 in. long by 96 in. diam. lined with the same silicious carbonate copper ore that is now used as flux. These were thought to be large at that time. The development of the 'basic' converter with a 'permanent' lining, however, resulted in the installation of the present equipment in 1912 and 1913.

The two Pierce-Smith horizontal converters are 36 ft. long and 10 ft. in diameter with a nominal capacity of 50 to 60 tons of copper. Each converter has 34 cast-iron tuyeres, that are supplied with air at 12-lb. pressure. The lining in the working segment of the converter is made of magnesite brick and is 12 in. thick except at the tuyere-zone where this is increased to 18 inches.

Magnesite brick is made at the smelter in a small plant adjacent to the converter building. Old brick-bats are pulverized and mixed with fresh raw magnesite in an ordinary clay-mill with a revolving bowl and two stationary mullers. The bricks are shaped in a hydraulic press at 240-lb. pressure, steam-dried at 90°F., and fired in a 15-ft. beehive kiln for which coal is the fuel. One great advantage in making the bricks instead of buying them, is the convenience of being able to make special shapes to suit exact requirements. The tendency has been to make bricks of large size in order to avoid mortar joints, particularly at the tuyeres, the point of first weakness. When a converter is being lined, the bricks are laid in thick magnesite clay.

The cars of hot matte approach the converter building on a bench above the working-floor, and immediately behind the converters, so that the matte is poured directly into them. Flux is dried in a small rotary drum, and is charged to the converters by means of boats lifted by one of two 50-ton Shaw electric cranes. Silicious carbonate copper ore from the steam-shovel mine at Ruth is the flux used, a typical analysis being as follows:

Copper	Silica	Iron	Alumina	Sulphur
%	%	%	%	%
2.31	55.9	15.2	6.6	0.2

A feature of the converter operations is the method of recording the performance on each charge. By means of this record the metallurgist is able to determine the efficiency of each step in the operation and to detect delays, faulty manipulation, or failure of equipment. The standards given in the last column below are based upon actual records obtained over long periods under varying conditions and with mattes of different copper content; they become part of the report made on each charge.

The following is a copy of one such report:

NEVADA CONSOLIDATED COPPER CO., STEPTOE PLANT
Pierce-Smith Converter No. 2

	Hr. Min.	Minutes per ton blister	Minutes per ton iron slagged	Standard minutes per ton
Initial bath	1—25	1.7	...	1.0
Charge, skim, and flux	4—10	5.0	...	6.5
Blow high	8—10	..	10.2	12.8
Blow copper	4—15	5.1	...	5.0
Ladle to receiver	1— 0	1.2	...	1.0
Miscellaneous delays	1—30	..	...	1.0
Total	20—30	..	...	..

Matte, tons .....148 Matte, copper, %.....37.1
Tuyeres ..... 31 Tons blister ...49.6
Bars of copper ...216 Tons per hour.. 2.42 Standard 2.41
Ratio to standard.100%

Each converter is equipped with a mechanical recording device by means of which the elements of time and position are automatically indicated on a chart. The dial on which this chart is mounted revolves by clock-work; the position of the converter on its axis is recorded by means of a pencil. It is therefore possible to obtain absolutely reliable data for the first column in the report,

irrespective of possible neglect or deliberate deceit on the part of the operators. It has been found that from a 30% matte 1.9 tons of copper should be blown per hour; from 38% matte, 2.35 tons; from 40% matte, 2.6 tons; and from 50% matte, 3.1 tons. From charge 2951, for instance, 2.42 tons was blown as against 2.41 standard; thereby making the efficiency of operation 100%. The value of this form of record is apparent in that it supplies a key to any difficulty around the plant. For instance, if the period 'Initial bath' is high, the possibility of some irregularity in tapping matte at the reverberatories or in transportation is suggested.

COPPER-RECEIVER EQUIPPED WITH POWDERED-COAL BURNERS

Slag is returned in molten condition to the reverberatories in 10-ton tilting slag-pots; copper is tapped into 10-ton ladles. The ladles are carried by the cranes and emptied into a tilting copper-receiver, fired by pulverized coal and lined with magnesite brick. The use of this receiver, which has a capacity of 50 tons, is advantageous in that it permits a converter to be emptied promptly, so that a new converter charge may be commenced at once. Mr. Kinnear has found that it is more economical to line the receiver with magnesite brick than with fire-brick as is usually done. The actual life of one magnesite lining has been 17 months and 22 days, and from this lining 42,462 tons of blister has been cast. By actual tests, although the cost of magnesite lining is about three times that of the fire-brick, the cost of lining per ton of blister in the case of the magnesite is about one-half that of the fire-brick.

The blister, averaging 99.5% copper, is cast in a straight-line conveyor-type machine. Ingots with a maximum weight of 450 lb. are delivered onto an inclined apron-conveyor that carries them through a vat of cooling-water and finally deposits them on the weighing-floor. The molds are cast of copper, these being a great improvement over the former iron molds. They last only a few months, but since they are made cheaply of blister, and when worn are simply thrown back into the converters along with the scrap, they are highly economical.

Secondaries, including shells and skulls from the ladles and converters and spilled material, are loaded into standard steel railway-cars by means of an orange-peel bucket and are returned to the reverberatories for re-smelting.

Below are the results of converting operations during the last six months of 1920.

Matte converted per month, tons	6271
Copper content, %	39.8
Blister per lapsed hour per converter, tons	2.38
Hot slag produced per ton blister, tons	1.90
Pot-skulls produced per ton blister, tons	0.11
Total secondaries produced per ton blister, tons	2.01

35-TON CAR USED FOR THE TRANSFER OF MATTE

COAL-PULVERIZING PLANT. Probably the most modern and efficient part of the smelting works is the coal-pulverizing plant, the construction of which was commenced in 1917. It was completed and put in full operation on May 1, 1918, and has since given continuous and satisfactory service. The increasing cost of fuel-oil and the consequent need for a cheaper fuel became evident early in 1917, and pulverized coal seemed to be the logical substitute. A number of plants for pulverizing coal and dis-

tributing the dust were in operation at that time but in the design of that at McGill departures were made from general practice, with a view to greater safety, cleanliness, and efficiency. The plant has been described in an excellent paper by Mr. Pomeroy,* presented at the New York meeting of the Institute in February 1920. The advantages of the system adopted over previous methods, as pointed out in this paper, are: (1) equal safety; no pulverized coal is stored at the furnaces; (2) greater ease of operation, since the furnace fires are regulated by valves in the branch lines leading to the burners; (3) better centralization of operations; the pulverizing machinery and the feed-control are in a single building, and the operating organization is distinct from the actual smelting departments; (4) greater cleanliness assured by placing the machinery under vacuum; and (5) greater flexibility of distribution whereby the pulverized coal, properly mixed with air, can be piped to any part of the works. Among measures for safety may be mentioned the erection of the building with structural steel, covered with corrugated sheet steel; concrete floors and reinforced-concrete bins, subdivided into fire-proof compartments for storage of coal, with adequate provision for detecting any excessive temperature, so that coal can be withdrawn from any bin in the event the temperature rises beyond the point of safety; sundry suction-pipes connected with suitable exhaust-fans for preventing the accumulation of dust in inaccessible corners; various precautions to prevent over-heating in connection with the operation of the dryers; emergency explosion vents and doors in the pulverized-coal bins, suction-headers, and elsewhere.

Run-of-mine coal from the storage-bins is fed by reciprocating pan-feeders to Pennsylvania single-roll crushers, from which it emerges as slack. It passes over Merrick weightometers and then to Ruggles-Coles type A-14 dryers, the fuel consumption of which is 0.75% on the coal dried. The dried coal is pulverized in eight 36-in. Bonnot mills, from which the dust is collected, by circulating air, to be stored in four 50-ton bins.

From cast-iron hoppers at the bottom of these bins the pulverized coal is drawn by feed-screws and dropped into the air current in the main suction-header leading to the distributing fans. Quoting from Mr. Pomeroy's paper: "These feed-screws are driven through roller chains by direct-current, variable-speed motors, the speed of which is regulated by a sheet-metal cone floating in the air current in the main suction-header, and known as the indicator. This device is connected, by light cable over sheaves, to the regulator mechanism, which, through a rheostat, governs the speed of the feeder-motors in proportion to the amount of air flowing in the suction-header. The proportion of air to coal may be varied within limits, but it has been found best to maintain a ratio of 50 cu. ft. of air to 1 lb. of pulverized coal. An instrument attached to the indicator continuously records the rate at which the air is flowing, and revolution counters record the operation of the feed-screws.

*A. I. M. & M. E., No. 158, Section 28.

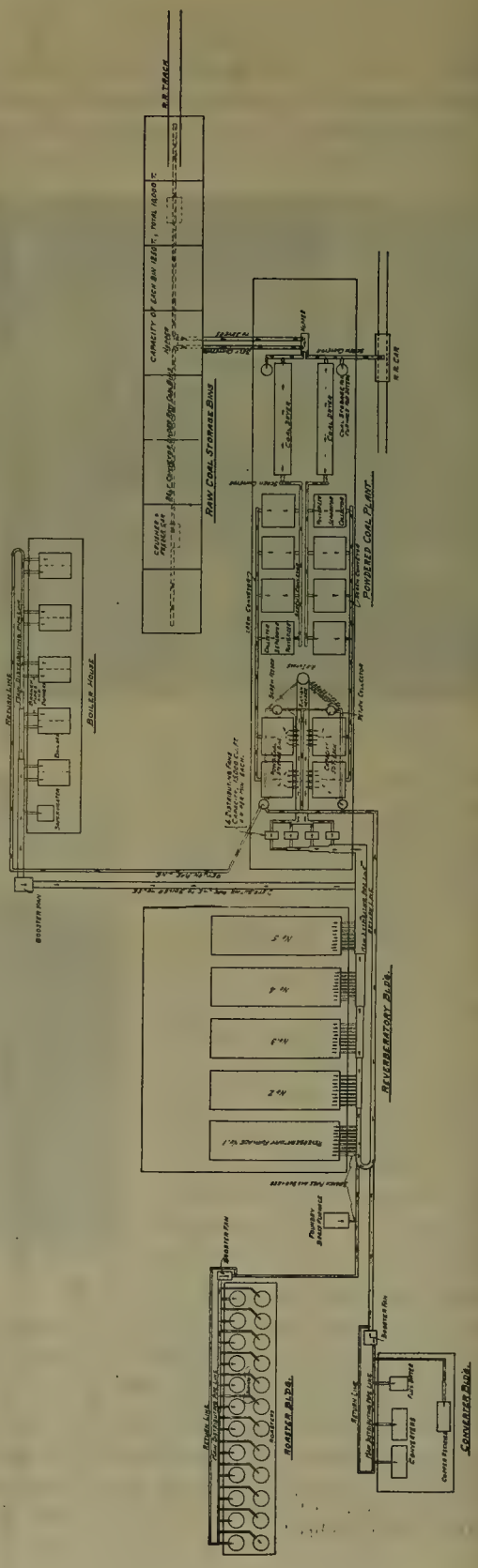


FIG. 2. DIAGRAM SHOWING THE FLOW OF COAL THROUGH THE PULVERIZING PLANT AND DISTRIBUTING SYSTEM

"The suction-header is connected to the auxiliary pulverized collectors, and to the return-line auxiliary collectors, and draws the necessary 'make-up' air from the top interior of the building, through a goose-neck extending up through the roof and down again to the indicator. This header is amply provided with explosion-doors, as the coal mixture is lean and explosive. The 50 to 1 mixture is too rich to explode, and hence this precaution is not needed on the distributing header.

"The distributing fans, receiving the proportioned air and coal through the suction-header, discharge the mixture through the discharge-header to the distributing header. The distributing header leaves the coal-plant of the total coal fed to the suction-header, depending on the amount of the mixture being taken off by the furnaces. Thus, even though no coal is being taken off for burning, the coal in the 50-ton bins is being constantly turned over, preventing spontaneous heating, so long as the distributing fans are in operation."

The 40-inch distributing header has been tapped and extended to serve the power-house, roaster, and converter plants, respectively, through 20, 12, and 10-in. lines, kept in circulation by means of booster-fans. Fig. 2 shows the flow of pulverized coal to the various portions of the smelter. The original distributing system for the roasters did not provide a return-line; it consisted only

FANS FOR DISTRIBUTING COAL TO THE SMELTER BUILDINGS

and passes along the firing-end of the reverberatory furnaces at a convenient distance from, and above, them. Opposite each furnace, a 7-in. drop-pipe leaves the bottom of the main through a slide-gate, regulating-valve, burner-pipe, and burner, to the firing-wall opening in the furnace. The main distributing header is reduced in diameter after each furnace take-off, in order to maintain the velocity requisite to prevent settlement of the suspended coal dust. After serving the reverberatory furnaces, the header makes a 180° turn upward and backward, returning to the coal-plant the remaining mixture through the return-header.

"The return-header enters the coal-plant and divides into branches which lead to the return-line dust-collectors and to the return-line auxiliary dust-collectors. These collectors are situated above the 50-ton pulverized-coal bins; the coal removed from the mixture is thus returned to be fed again to the suction side of the distributing fans. The quantity returning varies from 10 to 100% of a 12-in. pipe leading from the end of the main distributing header, with a 41-in. booster-fan 283 ft. from the header and 435 ft. from the roaster-plant. This did not prove entirely satisfactory, however, and a return-pipe has been installed to provide circulation similar to that for the reverberatories, thereby preventing the tendency for coal to accumulate in and obstruct the pipe.

Power-Plant. The power-plant at the smelter contains all the equipment necessary for generating electric energy for the mine, mill, and smelter; steam, and low- and high-pressure air for the mill and smelter are also supplied from the central plant. Power is transmitted to the mine at 40,000 and to the mill at 14,000 v. For electric generation there are six units, all operating at 600 v., 60 cycle, and 3 phase. Two of these units are Westinghouse turbines, one having a capacity of 3750 kva. at 3600 r.p.m. and the other 2500 kva. at 3600 r.p.m. Of the four engine-driven units, two are 1500-kw. Allis-Chalmers generators driven by 2250-hp. cross-compound

Nordberg steam-engines. There are two 750-kw. Allis-Chalmers generators driven by cross-compound Allis-Chalmers engines of 1200 hp. All of the turbines and engines are provided with condensing apparatus and auxiliaries.

Air for the converters is supplied by three blowing-engines, these all being of the cross-compound type on the steam-ends. The smallest of these units is rated at 450 hp. and will supply 5100 cu. ft. of air per minute at 60 r.p.m. The second unit is rated at 850 hp. and will supply 13,500 cu. ft. of air per minute at 70 r.p.m. The largest unit, 950 hp., will supply 15,000 cu. ft. of air per minute at 70 revolutions.

Low-pressure air for use in the mill comes from two General Electric turbine-driven centrifugal compressors or blowers. One of these is designed to deliver 20,000 cu. ft. of air per minute against a pressure of 15.2 lb. at 3450 r.p.m., and the other 20,000 cu. ft. against a pressure of 18.9 lb. at 3650 r.p.m. The turbines driving these blowers are designed to operate with high-, low-, or mixed-pressure steam. When operating on low or mixed pressure, the low-pressure steam is received from the discharge of the reciprocating blowing-engines. Two Laidlaw-Dunn-Gordon cross-compound compressors supply air at high pressure.

Steam originates from two sources: at the power-house boiler-room and from the waste-heat boilers in the reverberatory furnaces. The waste-heat plant consists of ten 400-hp. boilers set in five batteries. Eight of these are Stirling waste-heat boilers and two of the Babcock & Wilcox type. By-pass flues and dampers are provided so that either one or both boilers in a battery can be cut out of service for repairs. These waste-heat boilers do not have individual superheaters; instead, all of the steam leaving them is passed through a separately fired superheater of the Foster type, situated in the power-house boiler-room.

In the power-plant boiler-room there are 10 boilers set in five batteries. Two of these boilers are 575-hp. Stirlings, with Babcock & Wilcox superheaters, and eight are 400-hp. Babcock & Wilcox, four having B. & W. superheaters. Four are provided with grate-stokers for burning slack coal, and four of them have been arranged to burn pulverized coal. The results obtained have been so good that it has been decided to remove the stokers and equip all the boilers for firing with pulverized coal. In the course of a series of trial runs, combustion chambers of different sizes and various types of burners were tried; the arrangement that gave most satisfactory results is shown in Fig. 3. During a period of several months, 10 lb. of water has been evaporated per pound of coal. The temperature, as well as the carbon-dioxide content of the exhaust gases, has been low, with the boilers operating at 25% over-capacity. The size of the combustion chamber, as shown, together with the 'Bunsen' burner, which decreases the velocity of the coal-and-air mixture entering the furnace and allows intimate mixture of the secondary air and coal, has largely eliminated slagging under the boilers, which has been one of the objectionable features of coal-dust firing in power-plants. The dust that accumulates on the tubes does not adhere strongly and is easily blown by the ordinary steam or air soot-blower. Dust accumulating in the boiler settings is easily removed and sluiced by water through the old ash-launder originally installed for the chain-grate stokers.

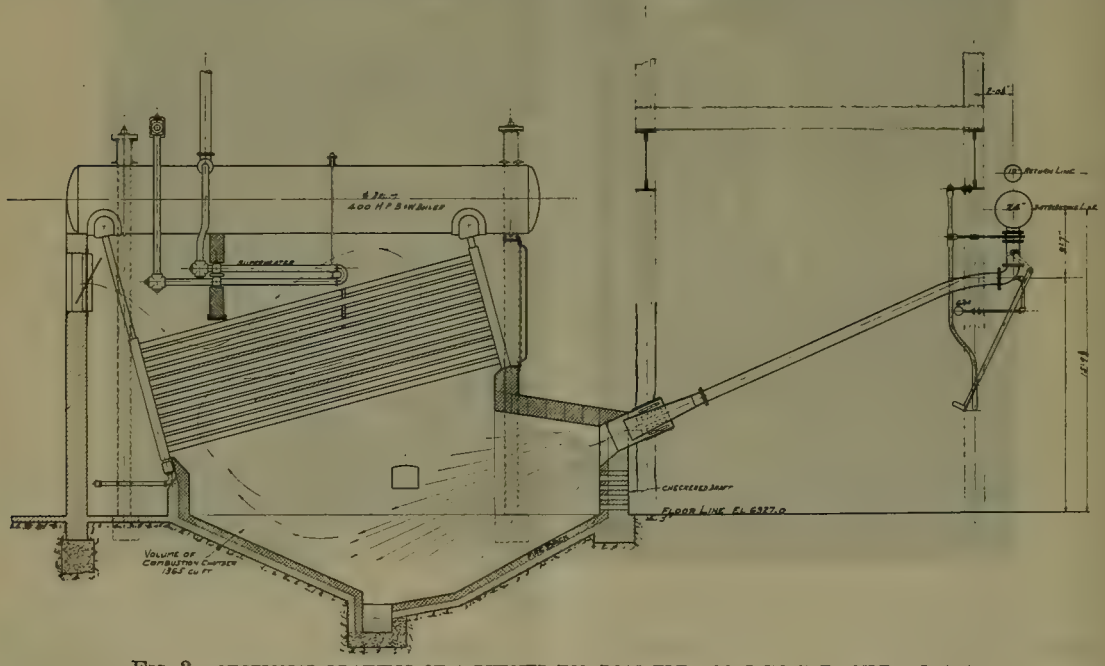


FIG. 3. SECTIONAL DRAWING OF A BURNER FOR POWDERED COAL IN THE BOILER-PLANT

Centralized Buying

By Edwin Higgins

In the United States there are 36 associations of purchasing agents, belonging to what is known as the National Association of Purchasing Agents, and embracing a total individual membership of about 3500. These men buy each year approximately $5,000,000,000 worth of supplies and equipment, including every known article of trade. Not included in the national body is the Purchasing Agents Association of Northern California, with 140 members, the total yearly purchases of which amount to $600,000,000. These figures are given to substantiate the statement that the idea of organized or centralized buying has been 'sold' to big enterprises in the United States. A recent development of the idea is mirrored in the appointment of municipal and State purchasing agents; in the selection of an official to do the buying for all of the farm organizations of a certain county in Maryland; and, finally, in the recent order by Charles S. Dawes, Director of the Budget, for complete co-ordination of all government purchases and sales, as a measure of economy.

As in other industries, the principles of centralized buying may be adopted with profit by operators of mines. A purchasing department is especially valuable to a corporation operating a large number of properties. Although it might not pay the operator of a single mine to employ a special purchasing agent, it is desirable that the buying be done by one man only. Whether the man be the superintendent, or some other official, he should devote some attention to the art of purchasing.

Some Advantages of Centralized Buying. Records of purchasing organizations throughout the country contain ample proof of the following advantages of centralized buying:

Economy: Because of purchases in large quantity, by contract or agreement;

Control of Expense: As a result of standardization;

Expedition of Delivery: Because of close contact with selling concerns, and a knowledge of transportation facilities;

Wider Market Vision: Because of intimate contact with salesmen and the possession of price lists, market reviews, and various periodicals dealing with transportation, labor, and general economic conditions; also because of close contact with purchasing agents in the same and other branches of trade.

An illustration of how some of these elements affect the ability to buy advantageously, is the experience of a Californian organization that was placed in a serious predicament during the summer of 1920 because of the lack of a particular kind of cable that was required to complete the installation of a motor. The electrician was discouraged because he was certain the cable could not be obtained on the Coast and because from three to four months would be required to ship it from the East. Moreover, at this particular time, no freight was moving in California on account of a strike. It was essential to make this installation; otherwise, the whole plant would have had to cease operation. The manager telephoned to the central purchasing office in San Francisco, he stated his needs, and he asked the purchasing agent to advise him within two hours as to what could be done. In exactly one hour the purchasing agent called him on the 'phone and advised him that he had found the cable in San Francisco, that it would be shipped by boat that night, and that he could secure it the next morning in Sacramento. The result was that this cable was at the plant by noon the next day, less than 20 hours from the time the electrician stated his needs. Without going into details as to how the purchasing agent found this cable, it may be stated that it was the only reel of cable of the type desired that was available in the State. The shipment by water was a bright idea of the purchasing agent and disproved the general belief that it was impossible at the time to secure any shipments whatsoever.

Selection of a Purchasing Agent. By far the most important problem in the organization of a purchasing department is the selection of the purchasing agent. The making of this selection is a difficult task, just how difficult may be indicated by a glance at the list of virtues that must be possessed by a successful purchasing agent. He must be resourceful, tactful, alert, honest, broad-minded, keen, and a profound student of conditions in countless lines of trade. He should be easy to get along with, hard to fool, and quick to make a decision.

Wilbur Hall, in discussing the ideal purchasing agent, states, in effect, that he must be a student of human nature, endowed with a strong spirit of co-operation, and a willingness and desire to learn. He must acquaint himself with the methods employed in the enterprise for which he acts, the uses of articles purchased, and the personnel of each department; he must know the products, the methods, and the character of the salesman with whom he deals; he must be a student of local, national, and even world markets; he must keep in close touch with transportation, labor, and general economic conditions; above all, he must know himself and the officials of his company.

In addition to the above requirements, there are certain characteristics that the successful purchasing agent must not have, such as 'swelled head', too much pride, or a tendency toward sharp practice. In short, it appears that the perfect purchasing agent must have all the virtues known to man and none of the defects. Obviously, such a man is not to be found, but there are many who approach this description, and who may de-

velop most of the required virtues by study and experience.

THE PURCHASING AGENT SHOULD DO ALL THE BUYING. The purchasing agent should do the one thing for which he is employed: *the buying*. The proportion of the buying done by him will be an exact measure of the success of his department. The difficulties that he will meet in bringing about conditions whereby he will do *all* the buying depend, to a certain extent, on the nature of the organization for which he is working. In order to discuss the subject concretely, let it be assumed that a mining corporation has established a purchasing department to handle the buying for all operations within a radius of, say, 200 miles. The first task of the purchasing agent is to convince the heads of the various departments that it is not his intention to curtail their authority, nor to interfere with their selection of materials or machinery. He must, by actual performance, prove to them that he can serve them to better advantage than they can serve themselves. This preliminary work is essential, for most men in responsible positions believe, and usually for good reasons, that they are capable of buying their own supplies and equipment. The chances are that the idea of centralized buying is new to them; therefore, it must be 'sold' to them.

It is a simple matter for the president of a company to say, "We will have a purchasing department"; it is another matter to make this department function properly. It cannot be done until the co-operation of the executives is secured; and this requires an abundance of tact and patience on the part of the purchasing agent.

THE RESULTS OF INDISCRIMINATE BUYING. It has been stated that the purchasing agent should do *all* the buying. Let us consider some of the situations that might arise when this regulation is violated. Take the case of the engineer in the central office who wishes to buy a certain piece of machinery. He reasons that he knows more about this particular item than does the purchasing agent and that he is therefore better qualified to buy it. Accordingly, he telephones or writes to one or more salesmen, and is interviewed by them. Finally, one of them receives his order—possibly through the purchasing department. What is the result? The standing of the purchasing agent is injured because the salesmen who were consulted, together with those who hear of the transaction, will assume that it is the engineer and not the purchasing agent to whom they must look. The purchasing department has been used only as a filing department, and because of lack of co-operation on the part of the engineer, the purchasing agent has missed receiving valuable instruction. The engineer has spent a great deal of time that might have been employed to better advantage.

On the other hand, suppose that the engineer had called in the purchasing agent, posted him on the particular details to look up in connection with the required machinery, and requested that prices be secured and tabulated. He might have written a letter for the signature of the purchasing agent, provided that the desired article was of such intricate design as to warrant such procedure. The least that he might have done would have been to direct that all bids be referred to the purchasing agent.

Had any of these three methods been followed, the salesmen would have realized that they must 'sell' the purchasing agent, and the engineer would have been protected against future loss of time. This educational work on the part of the engineer would better equip the purchasing agent to serve the organization as a whole. All data secured during the negotiations would be on file in the purchasing department and accessible for future use.

Suppose the article in question had been wanted by one of the mine superintendents, instead of by the engineer. A single letter to the purchasing agent should bring the desired results, as against the writing of many letters if the superintendent negotiates direct with the seller. The transaction may be analyzed in the same way as the one cited above, with the purchasing agent in the position of a figurehead. The superintendent is sometimes persuaded to sign an order by a traveling salesman who convinces him that it would be impossible for him to do better through the purchasing agent. Possibly the superintendent will send the purchasing agent a copy of the order. Such a transaction contains all of the objectionable features already mentioned, in addition to furnishing the men at the mine and in the office of the purchasing department some useless exercise in handling and filing copies of the order.

There are cases where direct buying is excusable, but they are few and far between. For instance, the mine superintendent might hear of a chance to buy a large quantity of drill-steel, or some other material, at a low figure. On the other hand, it is possible that the purchasing agent, having his ear to the ground, might know of a still better buy. If there is time for a query to the purchasing agent, it should be made; if not, such a purchase is warranted. There are times when the mine superintendent, operating at a distance from the central office, is able to buy something from a neighboring mine or from a local dealer. Where time is a main factor, purchases of this nature are warranted. Once in a while a particular article can be bought more cheaply by the superintendent than through the purchasing department. Although the purchase by the superintendent may be excusable, he should send all of the data regarding the transaction to the purchasing agent.

CO-OPERATION THE KEYNOTE OF SUCCESSFUL OPERATION. The purchasing agent who uses arbitrary methods, who ignores the beliefs and wishes of those for whom he has to buy, and who assumes that he alone knows what and how to buy, will certainly fail dismally. The engineer, superintendent, or other official who adopts a similar attitude toward the purchasing agent will assist that unfortunate individual in his failure. In other words, there must be toleration and a spirit of give and take, all of which means *co-operation* between the purchasing agent and the company officials. Under such conditions only can a purchasing department be made a substantial success.

The Beginning of the Cyanide Process on the Rand

By Andrew F. Crosse

*In the year 1891, when I had not been long on the Rand, I was asked by a client if I thought that gold was soluble in a solution of cyanide of potassium. Well, at that time I had honestly to confess that I knew nothing about the solubility of gold in alkaline cyanide. Soon after I received an invitation to be present at a trial experiment on the treatment of concentrate by cyanide. The trial was carried out on the Natal Spruit. I walked from my laboratory, which was in Von Brandis street, to Natal Spruit across the bare veld as it was in those days. I remember going into a corrugated-iron shed in which on one side there was a vat with a mechanical stirrer agitating a ton or more of concentrate from the Jumpers Gold Mining company's plant. This concentrate was clean, being, I believe, the product of frue vanners; it was kept in motion by a belt-driven stirrer, and was immersed in a strong cyanide solution. If the belt slipped, as sometimes occurred, the concentrate settled and had to be dug out by kafirs. It assayed between five and six ounces of gold per ton.

Why I mention this first exhibition of the cyanide process on the Rand is to show what a long way we have gone since then. This start began at the wrong end, namely, in treating concentrate, a comparatively coarse product, with a strong cyanide solution. The extraction of gold was not encouraging, and a much better result was obtained after roasting and chlorination. If the gold-recovery company had begun at the other end, and had treated the finest product, the slime, it would have soon tumbled to the fact that finely divided gold was readily and quickly dissolved in an alkaline cyanide solution. But the company was thinking more about the royalty it was about to get from the mining industry than about improving a young and undeveloped metallurgical process. As oxygen was necessary, various patents were taken out that covered most of the oxidizing agents known to chemists; but as there were, as far as I remember, no big lawsuits involved, none appears to have been effective. The oxidizing of a cyanide solution by such a compound as peroxide of sodium was bad practice, as I shall show later on.

Gold, in order to be dissolved, must be available. It was a question of fine grinding; the tube-mill was introduced; improvements in amalgamation were made. Where you have free gold or amalgamable gold in an ore, not to catch it would be like a shopkeeper driving away all his cash customers and only dealing with the credit customers; gold obtained by amalgamation is, to my mind, ready cash.

I was the first to try the air agitation of slime on the Rand at the time when I was consulting chemist on the East Rand Proprietary; my laboratory was on the hill close to the Driefontein and Angelo battery; a Pöhle air-lift pump was used for lifting the tailing. The idea struck me that air would be suitable for agitation purposes, so I had a connection made to my laboratory for bringing it through a half-inch pipe. I used a small vat with a conical bottom and a tube in the centre; with an ordinary mixture of cyanide solution and slime I obtained a good extraction in a short time. I did not apply for a patent, as I did not consider my process sufficiently new to warrant this. Later on I was told that I might have obtained protection; anyhow I saved the industry money, as a later application for a patent, by another, failed through my evidence. Unfortunately for the trained metallurgist, most of the banket ore requires only simple treatment. It is more a question of the mechanical handling and crushing of large quantities of ore and its reduction to a fine state of division, rendering all the gold accessible. Every young man on a cyanide plant knows this nowadays, but it took some time to find it out in those days. I remember in 1903 on the E. R. P. M. the coarse spitzluten concentrate was given a three weeks treatment in a special vat; but this extra treatment was useless. Hence the introduction of tube-mills, and a higher production of very fine sand. Having ground the coarse pyritic particles, the gold was readily soluble.

Now the product from most of the mines on the Rand is so clean, not having had time to be oxidized, that the cyanide solution is only slightly decomposed, and very little caustic lime is required to protect the solution. Of course this favorable condition is absent when old tailing or accumulated slime has to be treated. The first metallurgists to handle accumulated tailing had many troubles. The quantity of organic matter and ferroso-ferric sulphate in some of the deposits was considerable; the use of peroxide of sodium with the cyanide solution did not help matters. Sometimes even today the material can be improved before treatment. I will describe my ideas as to the preliminary treatment of slime that contains oxygen-absorbing materials.

The amount of oxygen in a ton of weak cyanide solution when fully saturated is barely 90 grammes. Therefore, a comparatively small amount of oxygen-absorbing material is injurious, and produces ferro- and sulphocyanides. I have carried out some interesting experiments by shaking up sand with a weak cyanide solution saturated with air, and then determining the amount of oxygen absorbed per ton so treated; I found that one ton of sand treated at the Angelo and Driefontein battery on the E. R. P. M. absorbed about as much oxygen as would be contained in five tons of cyanide solution; under these

*Abstracted from the 'S. A. Mining and Engineering Journal'.

conditions ferro- and sulpho-cyanides were formed.

When slime is agitated by air, the oxygen is replaced almost at once; but some classes of slime, even when freshly collected, can be improved by a special cheap treatment. To put it as tersely as possible, I have found in many cases that the consumption of cyanide can be reduced by a preliminary treatment with a weak alkaline solution of hypochlorite of calcium, care being taken to use less than is theoretically needed, as hypochlorite is a strong cyanicide if any undecomposed hypochlorite be left. I made experiments on finely ground pyritic concentrate from Barberton. By treating this material with a 0.13% KCN solution containing 0.127% CaO, 4 lb. of cyanide of potassium and 5½ lb. of causic lime were decomposed per ton of ore. A sample of the same concentrate was treated with a weak alkaline solution of hypochlorite of calcium; 2.1 lb. of available chlorine was used per ton of concentrate, and 0.57 lb. of caustic lime. The treated concentrate was washed, and it was found that only 1.3 lb. of cyanide and 2.7 lb. of lime were decomposed. No ferro- or sulpho-cyanide had been formed. A weak solution of hypochlorite of lime in lime-water does not attack gold or pyrite.

I made some tests with pyritic ore, from the Machavie gold mine, with the same results. I also made an experiment on fresh lime from the New Primrose about two and a half years ago. A weak solution of hypochlorite of calcium containing the equivalent amount of free lime was used; the experiment was made with distilled water, and there was no available chlorine left in the solution and only 0.001% of CaO. The treated slime was then cyanided with a 0.03% KCN solution; there was no decomposition of cyanide. This experiment was successful. The gold was quickly dissolved by agitation; the residue assayed only a trace of gold. I do not pretend that this method is advisable everywhere, but on some of the Far East mines I know it could be used with advantage and also in the outside districts where conditions are favorable.

Silver cathodes for use in the electro-deposition of copper are cleaned by placing them in contact with pure tin-foil in a boiling 10% sodium hydroxide solution until bright, according to H. W. Doughty and B. Freeman, in the 'Journal' of the American Chemical Society. They are then washed successively with dilute hydrochloric acid, dilute ammonia, and distilled water, rinsed with alcohol, and ignited to burn off the alcohol. The electrolysis is carried out as usual except that the electrode is not immersed in the solution until the current has been switched on. To remove the copper deposit, after the final weighing, the cathode is placed in a wide-mouthed stoppered bottle filled with a 10% solution of trichloro-acetic acid in aqueous ammonia (sp. gr. 0.90) to which an equal volume of water has been added. The copper is removed in 10 min. and the silver electrode is not attacked. Chloroform or carbon tetrachloride may be substituted for trichloro-acetic acid, but in this case the ammonia solution is made from 1 part of ammonia of a specific gravity of 0.90 and 1 part alcohol. The reaction is slower, and care must be taken that no sulphur compounds are present in the carbon tetrachloride that is used.

Johannesburg's Future

There is nothing so aglow with life as a mining town in the height of a sustained boom, nothing so flushed with hectic excitement, nothing offering such a lure to the adventurous of every race. But also there is nothing so dead as its abandoned husk—

"They say the lion and the lizard keep
The courts where Jamshyd feasted and drank deep."

Coolgardie and Silverton will have been forgotten by most of our readers, yet both were flourishing centres of mining before the near-by towns of, respectively, Kalgoorlie and Broken Hill sprang into fame. Kalgoorlie in its turn is now, and has been for several years past, to all appearances, gradually sinking to decay. What will be the fate of Johannesburg?

More and more the foci of gold mining on the Witwatersrand are moving to the extreme east; and, in a less marked degree, the extreme west of Johannesburg. The question has been asked whether it will one day be eclipsed by Springs, the thriving township of the Far East Rand. By 1930, some have predicted, there will be only two mines—the City Deep and the Crown—still working in the 35-mile stretch of the Central Rand. But even though that should prove to be the case, many authorities have great confidence in the future of Johannesburg as a South African industrial centre, irrespective of its gold activities.

It is true that the Rand, with 35 years of work and an output of gold to the value of about £650,000,000 to its credit, is becoming a fairly old field by all ordinary standards. But just as big mines take 'an unconscionable time a-dying' so do big fields. The first steps have been taken toward important economies in the working of the mines, whose cumulative effect should gradually bring many million tons of low-grade ore at present unworkable back into the region of profitable exploitation. A continuance of such a process would automatically extend the lives of at least some of the old properties of the district.

When all is said and done, however, it is a lamentable fact that on the whole field only two important new mines—the New State Areas and the West Springs—are at present being developed with a view to their joining the ranks of the producers. Until the Union government makes its leasing terms for new areas less stringent and until working conditions give the chance to the capitalist of an adequate remuneration in the case of successful exploitation of fresh ground, the Rand as a field will continue at the best to mark time. Whatever happens in this respect the comforting fact remains that most of the younger mines, particularly on the Eastern Rand, have many years of usefulness and prosperity ahead of them.—'Financial Times', August 13, 1921.

ENGELS COPPER COMPANY BREAKS FORMER RECORD FOR PRODUCTION

During August the Engels Copper Co. produced 1,030,000 lb. of copper, 16,000 oz. of silver, and 130 oz. of gold from its property in Plumas county, California. Ore treated during the month aggregated 28,000 tons, with extraction of 86% of the copper in the ore, including soluble copper. Based on sulphide copper, the above extraction was 90%, a record which is fully as good as that of any other company working with similar ore. Development of new ore is progressing rapidly and satisfactorily on the lower levels of both the Engels and Superior mines. Work on the seventh level of the Engels mine has been gratifying both as to quality and quantity of the ore, as compared with the upper levels. The work of driving the new adit on the tenth level of the Engels mine is progressing at the rate of 350 ft. per month. This will cut the orebodies of the Engels mine 500 ft. below the seventh, which is the present lowest level.

REDUCED FREIGHT-RATES AND SMELTING CHARGES BENEFIT PRODUCERS IN BRITISH COLUMBIA

Reductions in freight-rates and indications of reductions in treatment and refining charges are bringing closer the revival of mining among independent operators in the Slocan and other Kootenay districts. The Bunker Hill smelter recently reduced its treatment charges on British Columbian lead ores $1 per ton. With an assurance of a reduction in the freight-rates on ores and concentrates from Slocan points to Bradley, Idaho, the same to become effective on or before September 15, and with the reduction already effective on freight-rates between Bradley and the Atlantic seaboard, it is estimated that the total charge against British Columbian lead ores will be reduced $4.55 per ton. This it is hoped is but the beginning. Those interested are looking for further developments not only in respect of the cost but also in regard to the improvement of market quotations.

SURVEY IS MADE OF PROPOSED PORT ON GULF OF CALIFORNIA BY PHELPS DODGE INTERESTS

The extension of the Phelps Dodge railroad from Ajo, Arizona, to tidewater on the shores of the Gulf of California seems certain, says a report from Guaymas in Sonora. Completing a trip of inspection of St. George's bay on the north-east coast of the Gulf of California, the 'Silver Gate', under command of Capt. John Ross, and carrying a party of railroad construction engineers and experts, has returned to Guaymas. The expedition, which was under the management of the Tuscon, Gila Bend & New Cornelia Railroad, was for the purpose of making a sea survey of the proposed tidewater terminus of the new railroad, intended as an outlet for the products of the large copper producers of Arizona. A portion of the proposed line has already been completed and is in operation between Gila Bend, Arizona, and Ajo, Arizona. A distance of approximately 105 miles yet remains to be constructed connecting Ajo and the recently selected terminus site on St. George's bay. Accompanying the party were engineers, divers, marine experts, and underwriters, whose purpose was to ascertain tides, currents, seabottom conditions, and the general engineering features involved in the project.

At St. George's bay it is planned to build terminal facilities, including a long wharf, breakwater, and necessary warehouses and buildings. On account of the high cost of freight for rail shipments, the copper producers of Arizona have undertaken this means to afford them access to water transportation for their copper products. This will afford the nearest water terminal for points as far east as El Paso and would give the El Paso & Southwestern-Rock Island railroad a direct tidewater connection much closer than the port of Los Angeles controlled by the Southern Pacific Company.

'NET VALUATION' TO GOVERN FREIGHT-RATES ON ORES AND CONCENTRATES

Through its decision handed down in the Gold Hunter Mining & Smelter Co.'s case, the Interstate Commerce Commission has set up a barrier against the 'gross value' method of determining freight-rates on ores and concentrates and has prevented the already oppressive tariffs from mounting still higher. Had the Northern Pacific Railway Co., with its associates in the case, been favored with a decision permitting it to fix rates on the gross instead of net value, the path would have been opened for all other roads to make similar moves. The case has been in contest for a long period, it having been two years since the Executive Committee of the American Mining Congress met in St. Louis for the purpose of urging adoption of the 'net valuation', after a tentative report favoring the 'gross valuation' had been submitted by the commission's examiner assigned to the case.

UTAH CONSOLIDATED APPEALS DECISION IN APEX LITIGATION WITH UTAH-APEX COMPANY

The appeal of the Utah Consolidated Mining Co. from the decision of T. D. Johnson, Judge of the United States District Court for Utah, in its case against the Utah-Apex Mining Co., was heard before the United States Circuit Court of Appeals in Denver on September 6 and 7. Judge John E. Garland of Washington, D. C., presided. Attorneys J. A. Marshall of Salt Lake City and William E. Colby of San Francisco represented the Utah-Apex company, and John P. Gray of Coeur d'Alene, Idaho, and A. C. Ellis of Salt Lake City represented the Utah Consolidated company.

CALUMET & ARIZONA IS ABLE TO CONTINUE REGULAR DIVIDENDS

Because it was extremely frugal with its war earnings, Calumet & Arizona is able to continue its regular quarterly dividend of 50c. per share. At the beginning of the copper depression early in 1919, the company cut its dividend from $8 to $3 per share annually; in 1920 it paid $4 per share and since late last year has been paying at the rate of $2 yearly. Calumet & Arizona is one of the few American copper companies to continue in operation. It has taken advantage of the present situation to keep as many men as possible employed in development work and in filling the smelter beds, which have a capacity of 70,000 tons of ore. Of course.

there is only a limited amount of development work which can be done economically under present conditions, as the cost of maintaining the openings in the Bisbee district is high if too far ahead of mining operations. It is costing the company $125,000 to $150,000 per month to continue as at present. This cost, however, is more apparent than real, for the company is getting a good return for the money being spent upon the property in the way of developed ore reserves. Calumet & Arizona has been selling during the current year just enough copper to cover its monthly expenditures and by drawing on its cash reserve it is able to pay without embarrassment the dividend due the twenty-sixth of this month. After the payment of this dividend, it will have in cash and securities, but not including copper inventories, over $1,250,000.

UTAH STEEL CORPORATION WILL ENLARGE ITS PLANT AT MIDVALE

At a meeting of the stockholders of the Utah Steel Corporation on September 3, it was voted to increase the capitalization of the company from 7500 shares of preferred stock to 50,000 shares, and from 17,500 shares of common stock to 50,000 shares. The company will proceed to enlarge its plant at Midvale, and will install a blast-furnace and accessories at a cost of about $1,500,000. The company now has a capacity of 6000 tons of steel products per month; this will be increased to 25,000 tons. The company has made a contract to secure its iron ore from Iron county, Utah, and the Salt Lake Route will construct a branch line to handle the product.

DISCUSSION OF PROPOSED TARIFF ON MANGANESE

Decided differences of opinion were expressed, during the Congressional hearings on the tariff bill, by representatives of the independent steel companies and the domestic producers of manganese, regarding the proposed tariff on manganese and magnesite. As a result of the steel men's statements that little or no manganese was being produced in this country, the producers devoted most of their time before the committee to presenting evidence to prove that any minimization of the domestic manganese production was based upon obsolete records and reports, specific instances including the data prepared by the Federal Tariff Commission on the subject.

George H. Crosby, a prominent mining man of Duluth, Minnesota, stated that there is 36,000,000 tons of manganese-bearing ore on the Cuyuna range suitable for use in steel making. He stated that the steel men had ignored these deposits in making their assertions. He pointed out how $7,000,000 had been spent under war stimulation to develop these mines in Minnesota and that out of 34 mines only two are now operating. Even with normal conditions, he said, these mines will be unable to operate without a tariff.

Charles W. Potts stated that he represents a company that has investigated $750,000 in Minnesota and Arkansas that will be lost if manganese is not protected. He charged a close alliance between the 'so-called' independents of the steel industry and the Steel Corporation. He made a vigorous attack on the method employed in opposing the manganese tariff, taking strong exception to the statement regarding production. He introduced evidence to show that statements made by the steel interests in efforts to prove a lack of domestic supply of the mineral were based on reports that ignored immense tonnages that could well furnish the country.

John A. Topping, chairman of the Board of the Republic Iron & Steel Co., J. A. Campbell, president of the Youngstown Sheet & Tube Co., and C. A. Buck, vice-president of the Bethlehem Steel Co., were among the witnesses who took the opposite views and urged the committee to reduce the proposed tariffs on alloys. Mr. Topping declared the steel users of the country would be forced to bear an increased burden of $24,000,000 if the rates of the Fordney bill are enacted. Mr. Buck told the committee the steel industry should not be forced to carry the entire load of furnishing tariff protection for domestic alloy makers in order that they might develop.

THE PRICE OF ALUMINUM

Analyzing the relationship of the tariff to the aluminum industry, Herbert W. Smith, tariff expert for the American Mining Congress, declares that it is a reasonably safe prediction that the price of aluminum will be actually lower to the consumer in this country under tariff protection than it is under free trade, simply because the price of aluminum depends so largely on the quantity of possible production. He emphasized the fact that production will be highly increased through projects now being developed on the Pacific Coast for the reduction of bauxite ore, notably in the Klamath river of Oregon, by electric furnaces made possible by cheap water-power. This will be an important development under a tariff. With a certain amount of foreign sales eliminated, increased production may easily make it possible to sell aluminum at a lower price.

ARIZONA

Clifton.—It is reported that J. P. Hodgson, general manager of the Phelps Dodge Corporation, Morenci Branch, has stated that the boards of directors of the Phelps Dodge Corporation and the Arizona Company, Ltd., have reached an agreement whereby the holdings of the Arizona Copper Co. in the Clifton district are to be transferred to the Phelps Dodge Corporation. The agreement is yet to be ratified by the stockholders of the Arizona Copper Co. at a meeting to be held in Edinburgh, Scotland, some time in September.

Globe.—Mining claims in the Rambo and Quartzsite sections are being examined to determine the available tonnage with a view to the erection of a 25-ton mill to treat chloride ores by leaching.

Hereford.—The Alto Mining & Milling Co., recently incorporated for $250,000, has taken over several lead-silver properties in the Moctezuma canyon in the Huachuca mountains.

Kingman.—Development now being done by the United Eastern company, on the 300-ft. level of the Big Jim claim, has opened the orebody preparatory to stoping. A tram is to be installed to transport this ore to the mill. The new shaft on the north end of the property has reached a depth of over 500 ft. and is being sunk rapidly. At the 800-ft. level a cross-cut is to be run to the vein and lateral development done.——Equipment for sinking a winze from the 700-ft. to the 1000-ft. level of the United American is now in place and active sinking is to be commenced at once. This winze will be sunk on the ore-shoot that was recently opened on the 700-ft. level.——S. P. Landau has taken over the Red Gap mine situated in the Black Canyon range of the Weaver district and owned by the Charles brothers. The vein is faulted and development work in the past has been difficult.——E. Lafierrie has secured an option on the Diana mine at Chloride. The mine is an old producer. The shaft is down 300 ft. and levels have been run at 100-ft. intervals. A large tonnage of ore has been shipped in the past and treated in the Mineral Park mill. The development outlined at present is to sink the shaft to the 500-ft. level and open the old ore-shoot at depth. The ore is silver-gold.

Yuma.—It is announced that W. J. Johnson is to erect immediately a 25-ton mill at his Kofa Queen property in the Kofa mountains 55 miles north-east of Yuma.

CALIFORNIA

Downieville.—The Brush Creek mine, owned by F. R. Wehe and F. L. Cole, has been bonded to the company operating the Kate Hardy mine, at Forest. The location is between Goodyear Bar and Mountain House and the property is regarded as having great possibilities. It is estimated that in order to reach the orebody at depth a tunnel 2500 ft. long will have to be run; this is already under way.——Gold-bearing gravel, believed to be a branch of the main channel, has been uncovered in the White Bear mine. The gravel pans well and work has now started for the purpose of tracing the gravel to the main lead. Prospecting for the channel has been in progress several months. Several years ago the channel was mined profitably but the lead was lost and efforts to recover it have failed heretofore.

Georgetown.—Gold bullion to the value of $10,000 resulted from a clean-up at the five-stamp mill of the Grit mine, at Spanish Dry Diggings. Walter King, who is superintending operations, declares that the company is milling high-grade ore.

Hayden Hill.—The organization of the Hayden Hill Consolidated Mining Co. has been completed, and the promoter, H. P. Anderson, is preparing to start work on the properties. These include the Blue Bell, the Coyote, and other claims not far distant from the Juniper, in which remarkable finds have recently been made. The Blue Bell was opened in 1867 and the records show that it produced a total of $125,000, mostly on the surface. The shaft is to be sunk deeper. Anderson's associates in the company are N. V. Wemple, George N. McDow, and Russell Brownell.

Jackson.—Capacity operations will be resumed shortly in the Kennedy mine. The ore will come principally from the 3900-ft. level, although the lowest workings are 4165 ft. deep. The ore is free-milling, averaging about $7 per ton in gold. The property is equipped with a modern 100-stamp mill, which was shut-down nearly two years ago when the mine was flooded to extinguish a fire. It is announced that 17,000 tons of tailing from the old chlorination works have been sold to the Selby smelter. The tailing can be used to advantage in fluxing other ores.

Randsburg.—John M. Fox, superintendent for the California Rand Silver company, reports that stoping has been started above the 450-ft. level, immediately south of the Grady lease, the ore broken being of good grade. The stope above the 9th level, south drift, continues to produce its regular tonnage of shipping ore. A new raise has been started from the south drift on the 10th level, the grade of ore improving somewhat as the raise advances. The No. 2, or new working shaft, was sunk 21 ft., making the total depth 335 ft. Production of smelting ore has been maintained at 10 cars, averaging 44 tons each.——On the Silver Reef No. 1, a shaft is now being sunk near where the diamond-drill had been operating; the diamond-drill has been moved over to Silver Reef No. 2 and is under full headway.——Bisbee and Brey have started a cross-cut at 450 ft. In the meantime the Sullivan diamond-drill, on the 4th level, has reached a point 200 ft. east. The station at 400 ft. is well ventilated, lighted, and equipped for the drillers in charge of the electric drilling machine. A ⅞-in. core is taken. At the Silver Moon lease sinking is still progressing; at 112 ft. in the bottom of the shaft a stringer, apparently a gold-bearing stringer, has come in.——The Silver Bar lease is improving; assays show $20.67 in gold with no silver.——A sample shipment of silver ore from the Hicks lease, on the K. C. N. claim, has been sent to the smelter. Errecart and Lombard, on the same claim, are making good headway in sinking.

Redding.—The Little Nellie mine near the Mountain Copper Co.'s Iron Mountain mine has been shut-down by the Pittsburg Gold Mining Co. Only watchmen are left on duty. The only quartz mining operation in Shasta county is a new 2-stamp mill near Buckeye, which has been started by George W. Dix and John Grigsby on pocket-ore from the Ida Hiatt mine. The results exceed expectations.——The Shasta Zinc & Copper Co.'s smelter at Ruby Hill is closed temporarily pending the construction of a refining furnace. It is found that the zinc-oxide produced is not quite white enough. J. C. Kinnear, smelter superintendent for the Nevada Consolidated Copper Co., has succeeded R. L. Beals as superintendent for the Shasta Zinc & Copper Co. ——Construction of the Mountain Copper Co.'s tram from the Hornet mine to Matheson, the new town on the Southern Pacific, is being rushed. Five towers are in place. The tram will be ready for operation by January 1.

Sutter Creek.—A. S. Howe, superintendent of the Central Eureka mine, has let a contract for sinking the shaft, which will be deepened 200 ft. The bottom of the shaft is in slate, showing numerous flat quartz stringers which are well mineralized. These stringers dip westward toward a gouge-vein lying behind the shaft on the 3900-ft. level, the present lowest level of this property, and there is a possibility that this gouge-vein may carry ore at greater depth. During August the mill crushed 3136 tons of ore, yielding more than $42,000 in gold.

Tuolumne.—The Sunny South and Wallace claims, commonly known as the Bacigalupi mine, have been bonded to Charles Rives and S. M. Westwood. Systematic development will be undertaken.

COLORADO

Black Hawk.—Settlement made on a 20-ton shipment of ore from the Ross lease, on the Frontenac, by the American Smelting & Refining Co., was at the rate of 2.92 oz. gold, 17.97 oz. silver, and 4.9% copper. Ten tons of mill-ore returned 17 oz. gold on the plates and 11 tons of concentrate assaying 2.28 oz. gold and 9.96 oz. silver.——The Mountain Chief shaft on Tip Top mountain at Apex, is being re-timbered. The property prior to the silver slump in 1893 was operated at profit, but has long remained idle.

Cripple Creek.—Bulkeley Wells, of the Metals Exploration Co., has been elected a director of the Cresson Consolidated Gold M. & M. Co. and Golden Cycle Mining & Reduction Co., succeeding Irving T. Snyder, formerly vice-president and general manager for the Vindicator Consolidated company. The association of Bulkeley Wells with the Carlton interests is significant, in connection with the report that Eastern financiers are said to have undertaken to finance deep-mining operations in the district.——Oliver H. Shoup, associated with Ralph D. Brooks, vice-president of the Mid-west Refining Co., William D. Waltman, Rodney J. Bardwell, and Lester S. Grant, have taken a 5-year lease on the Ajax properties on Battle mountain and have commenced work. Thirty-five lease applications have been filed; five sets have started work on ground allotted and a score more will be in operation within ten days.

An important surface discovery has been made by lessees of the Free Coinage Gold Mining Co. at the Pinto mine, on the summit of Bull hill. A new vein has been opened at shallow depth on the west line of the property with specimens showing sylvanite and free gold. Assays run in the hundreds of dollars.——A rich ore-shoot has been opened at the 13th level of the S. Burns shaft of the Acacia company, adjoining the Free Coinage group on the west and south, by the Le Brun Leasing Co. The ore was found on a junction of the Eagle and Wilson veins.

The output of the mines in the Cripple Creek district for August, as shown by the reports of the mill managers, totaled 39,508 tons of an average value of $10.42 per ton and a gross value of $411,792. As compared to the figures of the preceding month an increase is shown of $117,211.

The total production for the months of January to August, inclusive, is $3,649,472 and the total production to date $409,418,477.

Georgetown.—Operations have been resumed at the Silver Plume tunnel and at the Bellevue-Hudson mine.

Ouray.—Four sub-lessees of the Barstow mine have about 15 cars of smelting ore mined, and are in receipt of returns on two cars that netted $8000 each. The third car is estimated at $10,000 and the entire 15 cars are expected to return around $100,000 net. The shoot continued for 100 ft. in length. The Barstow Mining & Milling Co. ceased operations about 8 years ago and the property is under lease to its former manager, Clifford R. Wilfley, who with sub-lessees has taken out in excess of $150,000 since the company ceased operating.

Telluride.—August shipments totaled 140 cars of concentrate as compared with 95 cars for the same month last year. The mills shipping were Smuggler Union, 80 cars; Tomboy, 55; and Liberty Bell, 5, this being from the clean-up prior to shutting down.

IDAHO

Coeur d'Alene.—The West Hunter Mining Co. has drifted 150 ft. from the main tunnel and attained a vertical depth of 800 ft. One selected sample yielded 12% lead and 26 oz. of silver per ton. The drift should enter the ore-shoot in 100 to 125 ft. This vein is the You Like and there is 6000 ft. of it. The company has 1100 ft. of the Morning, or north vein, which parallels the You Like, and is 500 ft. distant. ——Lessees in the upper workings of the Gold Hunter are reported to be mining rich silver ore.

A rich find has been reported in the Cedar Creek Mining company's property in the Murray section. The Cedar Creek is an old property in which a cross-cut 2500 ft. in length was driven to the vein. Drifting has been in progress all season and the vein followed for about 750 ft. Recently a shoot of high-grade silver-lead ore 18 in. wide was uncovered in the face, assays from which gave returns of from 50 to 60% lead and 25 to 31 oz. silver.

Development on the property of the Sterling Silver Mountain mining property, on Big Creek, has been resumed, according to Matt Baumgartner, secretary. A cross-cut has been driven about 600 ft. and will be continued 200 ft. farther to reach the main vein which lies at a depth of about 400 feet.

According to reports funds to finance the Northside Railway Co. will be raised. The Northside railway will be about 10 miles long, connecting Prichard, where connection will be made with the Evanville-Prichard branch of the O.-W. R. & N. and the historic town of Murray, for three years shut off from railroad communication with the outside world. Tributary to the proposed railway lie such well-known mining properties as Jack Waite, Blue Bird, Lead Crystals, Columbus, Ironsides, Terrible Edith, Aulbach group, Buckeye Boy, Giant Ledge, Monarch, Paragon. Bear Creek, Cedar Creek, Sabina, Phoenix, and C. & R.

MICHIGAN

Houghton.—There has been shipped out of the Lake district by boat so far this season, 22,880,000 lb. of copper, divided as follows: May (including a few days in April), 5,310,000 lb.; June, 5,858,000; July, 6,536,000; and August, 5,176,000. For the same period in 1920, the total was 37,668,000. In addition to water shipments, probably 7,000,000 lb. has gone out by rail, making the total approximately 30,000,000 lb. This compares with an estimated production for the five months of 23,000,000 lb. Usually at this time of the year, when navigation is drawing to a close, copper shipments increase. The reverse is true this year, however, less copper having been shipped in August than during any previous month of the season of navigation. The August figures show a falling off of 1,360,000 lb. from the month of July. In August 1920 tthe total copper shipments by water were 16,860,000 lb., an increase of nearly 7,000,000 lb. over July of that year.

When operations are resumed by Calumet & Hecla, one of the first projects to receive attention will be the haulage drift or level, at 8100 ft., in the conglomerate branch of the property. This drift was about 80% completed when mining work was suspended. It will be pushed through as rapidly as possible, for once opened it will serve to reduce greatly the cost of mining at this depth. The level will serve all of the conglomerate shafts, which, with the exception of the two terminal shafts, No. 12 and the Red Jacket shaft, will eventually be closed. Not only will this drift enable the company to mine out the shaft-pillars to advantage but it will make easier the task of mining the ground below the level, of which there is still a great volume. It requires at least 15 years to take out the pillars in a single shaft. In No. 8 shaft this work has been under way for 10 years and there is approximately five years more work to be done.

MONTANA

Butte.—The management of the Butte & Superior Mining Co. reports that in cross-cutting south on the 2200-ft. level it has just cut a streak of copper ore assaying 7.6% copper for the first two feet; the following four feet assays 6%, and the following 12½ ft. assays 3.3%, which gives an average for the vein of 18½ ft. of 2.6% copper.

NEVADA

Goldfield.—The Silver Pick has opened a full face of $32 ore in the cross-cut to the vein in the lease on the Red Top. This proves the ore-shoot for 110 ft. on the dip of the vein below the third level. Little work has been done in the cross-cut since the ore was found, as the miners have been cleaning the chutes from the fourth level of the Red Top down to the second of the Laguna. These chutes are caked with waste, which will have to be removed before the ore from the cross-cut can be put in them. The ore-bins now contain 100 tons of ore of an estimated value of $40.

Gold Hill.—The United Comstock Mines Co. is making rapid progress in its construction program. The past 30 days has witnessed remarkable strides forward on the American Flat at the portal of the haulage-tunnel. Pouring of concrete has been started from the 140-ft. tower, the mixed concrete being carried direct to the foundation forms for the fine-ore bins by means of chutes. Crushed rock and sand is prepared at the plant on the hillside east of the railroad, and is carried from that point by gravity tramway to the mixer, situated at the foot of the tower. By this method 125 yards of concrete can be handled every eight hours. The upper section of the excavations for the coarse-crushing plant of the 2000-ton mill is now nearing completion and at the lower end forms for concrete are being put in place. Frame-work on the carpenter shop is up and to the west of the tunnel portal, the lodging house, mess hall, and general office building will be ready for occupancy in about two weeks. These buildings are modern in every detail, the rooming house having shower baths, and club room in connection. The cook- and dining-house will have its own electrically driven laundry and refrigerating plant. The office building will house the general offices of the company as well as the engineering staff. Underground, records are being made in driving of the haulage tunnel, the portal end now being in about 2400 ft. It is expected to make the connection with the Knickerbocker shaft heading about the first of the month. This tunnel, through which ores will be transported to the mill from the mines, is now about 70% completed.

Hornsilver.—The ore-shoot on the 580-ft. level of the

Orleans mine has been opened for a length of 300 ft. The vein strikes south-east and dips north-east. There is on this level a cross-cut from the shaft and drifts north-west and south-east from the cross-cut. The North-west drift is the centre of the vein. The work on this level up to a short time ago was done by J. W. Dunfee, former holder of the lease and option and from whom the Orleans Hornsilver company acquired the mine. Before Dunfee started drifting south-east, he turned south to the foot-wall of the vein from the north-west drift and then he drove for 170 ft. on this wall, disregarding the opposite wall because he had found all of the ore on the upper levels on the foot-wall. At the 170-ft. point he drove a cross-cut to the centre of the vein and found ore. From the 170-ft. point he continued the drift south-east in ore for 130 ft. Now the Orleans Hornsilver company has driven three cross-cuts from this 170-ft. length of the south-east drift, each entering the shoot and indicating that Dunfee paralleled it for 170 ft., he driving on the foot-wall, with the shoot in the centre of the vein. The three new cross-cuts have opened ore as follows: No. 1, 6 ft., $6 ore; No. 2, 8 ft., $20 ore; and No. 3, 4 ft., $30 ore. The 130-ft. length of the south-east drift is in ore varying in width from 4 to 15 ft. and of an average value of $30. Sinking of a winze from this 130-ft. length has been stopped at the 50-ft. point, with the bottom in $30 ore. The fifth level is being continued in a 3-ft. width of $45 ore and in addition to this there is a 3-in. width on the foot-wall that assays $400. The next work of the company will be to sink the shaft 100 ft., continue the south-east drifts on the fifth and sixth levels, raise from the sixth level, and explore the vein on the levels above the fifth. It is thought that some of the drifts above the fifth level are not in the vein and at no place has the vein been cross-cut from the foot-wall. Goldfield and Tonopah men are seeking options on ground near the Orlean, but the owners are holding out for impossible prices on the strength of the ore on the bottom level of the Orlean.

Tonopah.—Operations throughout the Tonopah district are normal. Every mill in the camp is running at capacity with heavy shipments of custom ore being made to Millers. Record bullion shipments are being made by the West End and Tonopah Belmont companies, with the Tonopah Extension, Tonopah Mining, North Star, and others increasing production. Late developments in the North Star are said to be important. Lessees on the Montana, Midway, Halifax, and other properties are mining good ore. The West End company has started mining of the rich vein on the 1000-ft. level of the Halifax, opened by the Oshund lease.

All of the State police that were sent into Tonopah during the strike have returned to Carson. The last few of the officers left recently.

Tule Canyon.—The Silver Hills is employing only three or four miners and a foreman at the Ingalls, merely enough to comply with the terms of the option. It is reported that the San Francisco men interested in the company will soon be in Tonopah to consult with W. B. Mercer, who, with Mrs. W. A. Ingalls, owns the mine. It is understood the company is considering abandoning the work at the Ingalls.

OREGON

Kirby.—Some high-grade gold ore has been found by Mansfield and Lofland, of Williams, Oregon, on the headwaters of Lightning creek, 15 miles west of Kirby. A 35-ft. shaft has been sunk showing gold all the way down. In early-day mining more gold was taken out of the Lightning Gulch diggings, than any other district in this region. This new property is about 25 miles west of the famous Boswell mine recently re-opened.

Gold Hill, Nevada. Dumps of the Imperial Mine in the Centre

Selma.—The Myrtle gold mine nine miles below Selma, owned by Frank Hobart and B. W. Fowler, has been reopened. Over 100 tons of ore running $50 in gold is on the dump ready for milling. A 3-ft. vein is opened with 400 ft. of drifts. New equipment will be added.

Talent.—A large body of ore has been uncovered in the Shorty Hope mine, an old-time producer recently re-opened. ——The uncovering of a large body of ore, rich in platinum, on Anderson creek six miles out from Talent is also reported.

UTAH

Alta.—At the Alta Tiger mine, which lies between the Emma and Flagstaff properties, 10 in. of high-grade silver-lead ore has been opened, according to David Phillips, manager. Samples of the ore show returns running from $2 to $4.40 in gold, from 19.6 to 153.6 oz. in silver, and from 17.5 to 41.4% in lead. As the ore is picked down it will average about $86.50 per ton.

Big Cottonwood Canyon.—Ore is being hauled steadily from the Woodlawn Mining Co.'s ore-bin to the railroad terminal. A shipment of 53 tons made recently gave average assays of $1.45 in gold, 45.78 oz. silver, and 12% lead. The gross value was $51.04 per ton and the net value $34.60, or $1834 for the lot. The deposit from which ore is being mined is in fissure No. 2, in a raise connecting the

fifth and sixth levels, according to W. J. Lawrence, manager.

Bingham.—It is rumored that the Bingham Galena Mining Co. has entered into negotiations to acquire the Lost Packer mine in Custer county, Idaho, which property is controlled by the James Ivers estate of Salt Lake City. From 1904 to 1915 the Lost Packer produced about $800,000 worth of metal. The property is equipped with a smelter of 100 tons capacity, and produced a matte averaging 45% copper, 25 oz. silver, and 8 to 10 oz. gold per ton. Since the death of James Ivers in 1915 the property has been idle. A statement from the management was to the effect that about 20,000 tons of ore was in sight, averaging about $5 per ton. A 50-ton oil-flotation plant was constructed in 1915, but was operated for only a short time.

Eureka.—The Water Lily shaft at the Chief Consolidated mine is now down a distance of 700 ft. It is expected that sinking will be continued until the water-level is reached, when drifting will be started. The north-east drift on the 1600-ft. level of the Iron King mine is now in quartz formation; ore is expected shortly. N. W. Roberts, superintendent, has put on a second shift to speed the work.——Shipments for the week ending September 3 totaled 155 cars, as against 161 cars for the preceding week. The Tintic Standard shipped 39 carloads; Chief Consolidated, 38; Dragon, 12; Victoria, 11; Grand Central, 11; Eagle & Blue Bell, 10; Centennial-Eureka, 8; Iron Blossom, 7; Swansea, 5; Bullion Beck, 4; Iron King, 3; Colorado, 3; Sunbeam, 2; Eureka Mines, 1; and Gemini, 1.

A party of mine operators recently visited the prominent mines in this district, under the direction of Imer Pett, general manager for the Eagle & Blue Bell Co. The party included L. S. Cates, D. D. Moffat, and H. C. Goodrich, of the Utah Copper Co.; G. W. Lambourne, president of the Judge allied interests at Park City; and A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress. It was the first trip Messrs. Cates, Lambourne, and Moffat had made to this district.

Fish Springs.—Production is to be resumed at the Carnation mine, according to announcement made by T. E. Wessel, who will have charge of the property. Recently a new deposit was discovered that contains a high-grade silver-lead ore that averages from 35 to 40% lead and about 250 oz. in silver; it has a low silica content and an excess of iron. Shipments will be made by trucks to Gold Hill, 36 miles north of here, and thence by way of the Western Pacific to Salt Lake valley smelters. The Fish Springs district is noted for the high-grade ore it produced. From 1890 to 1914 the old Utah mine shipped ore that averaged 128.35 oz. in silver and 44% lead, and had a gross value of $1,580,186.

Moab.—Andrew Nylund and associates recently made a shipment of 40 tons of carnotite ore which netted them $20,000. The ore came from the Gateway district, south of here, and was sold to buyers at Montrose, Colorado. Mr. Nylund is now engaged in prospecting for carnotite in eastern Utah and western Colorado.

Park City.—Exploratory work in connection with the recently discovered high-grade silver-lead-copper orebody in the Silver King Consolidated mine is proceeding slowly, owing to trouble with water. The ore-shoot has a width of 3 ft., and average returns are about $200 per ton.——Ore shipments for the week ending September 3 totaled 1914 tons, an increase of 536 tons as compared with the previous week. The Silver King Coalition shipped 771 tons, Judge companies, 705; and the Ontario, 438.

Salt Lake City.—At a meeting of the directors of the Utah Copper Co., on September 8, a dividend of 50c. per share was declared, payable September 30. This will call for a total of $812,245 and bring the grand total up to $114,758,632.

WISCONSIN

Cuba City.—The National Zinc Separators are now running full time, and shipments of high-grade water-white acid to Eastern points are being made daily. Receipts of raw zinc ore which furnishes the acid-making base have been increasing recently and run from 350 to 500 tons, weekly.——The Zinc Hill Mining Co. is advertising the sale of its big stock of coal at $5 per ton f.o.b. mines, which would indicate that this company does not intend to resume mining for some time.

Highland.—Local co-partnership companies are operating on sub-leases of the New Jersey Zinc Co., searching for deposits of carbonate-zinc ore, with fair success. About 1000 tons of this class of ore is available for shipment.

Livingston.—The Yewdall mine is operating with a large force; from 350 to 400 tons of 25% zinc concentrate is produced weekly. This is delivered to the sulphuric acid plant of the National Zinc Separating Co., at Cuba City. The high-grade residue blende is piling up; 66° Baumé is bringing $18 to $20 per ton, f.o.b. maker's works.

Platteville.—The Savage-Menke Mining Co. has opened a deposit of lead ore and is producing steadily. A specimen found recently weighs 20 lb., and is crystallized in perfect cubes.

The Zinc Roofing & Products Co., composed of leading zinc operators of this field, is meeting with exceptional success in promoting the expansion of the metal industry by extensive use of its products valuable in the building trades. The State government is a recent acquistion and contracts have been entered into for the use of zinc shingles and corrugated zinc in repairs to buildings at State institutions and for those that may hereafter be constructed.

Higher prices for lead ore, late quotations going as high as $55 per ton for 80% ore, is stimulating many miners out of employment to secure leases in old lead mines.

WYOMING

Cheyenne.—Two 400-barrel oil-wells have just been brought in by the Sinclair Consolidated Oil Corporation's Wyoming subsidiary. This announcement was first official admission that the Sinclair company was actually operating in Wyoming fields though it was known that the Wyoming subsidiary existed. The company has now about 1200 bbl. production per day available in the Salt Creek field and seven wells in the Osage, Wyoming, field. The two new wells are in Salt Creek field on a 160-acre lease, which is considered one of the most valuable in the State. It is entirely proved territory, and one of the Sinclair wells on this lease is said to have produced an average of about 500 bbl. daily for a year. Active development on the property has been delayed until recently when the lease was approved by the Secretary of the Interior.

BRITISH COLUMBIA

Alice Arm.—The North Star has made a shipment of 90 tons to the smelter at Anyox. As development proceeds this property increases in promise and there are indications that it will become one of the regular shippers of the district.

Cranbrook.—MacKenzie & Mann has given a bond on the Stemwinder mine, at Kimberley, to the Federal Mining & Smelting Co. The Federal company had an option on this property in 1917-'18 and did a considerable amount of diamond-drilling before relinquishing the option. It probably has been re-attracted to the property by the splendid development of the Sullivan mine, which last year provided more than 90% of the zinc and nearly 70% of the lead output of the Province. Though the terms of the bond have not been announced, it is likely that better terms have been obtained, as during the term of the previous bond zinc was selling at about 10c. and lead at about 8c. per pound, and

money was a great deal easier than it is at the present time. Diamond-drilling is to be commenced at once and continued through the winter, and it is stated that in the event of a large orebody being developed by this means the Federal company will erect a lead smelter and electrolytic-zinc plant at or near the mine.——Frederick Laist, of the Anaconda Copper Company, recently visited the Sullivan mine and the Crow's Nest Pass Coal Co.'s collieries in company with S. G. Blaylock, of the Consolidated M. & S. Co.

Kaslo.—O. C. Thompson, formerly of the North Star mine, at Kimberley, who recently bonded the Utica mine here, has brought a gang of machine-men from Kimberley, and is continuing the long tunnel to cut the orebody at depth. As soon as connection has been made he expects to employ 30 to 40 men. By the terms of the bond Thompson has to spend not less than $2000 monthly on development.

Revelstoke.—A find of silver-lead ore on the Noble Five group, Trout Lake district, is reported. A large sample of the ore has been brought in averaging $200 per ton. The body just uncovered is said to be substantial and the result no doubt will be renewed activity in development.——Mike Penrose, an old-time prospector, claims to have discovered on Canon creek a few miles to the south of the town of Golden, a vein of free-milling gold ore 25 ft. in width which he traced 6000 ft. There is no report yet as to assay returns on his samples.

Stewart.—The first consignment of concentrate from the Premier mine was shipped from here on the 'Prince Albert', on August 23. It consisted of 160 tons, valued at $1750 per ton, giving it a total value of $280,000, or nearly three times what R. K. Neill and associates paid for the mine, some three years ago. The consignment was derived largely from the milling of cullings of high-grade ore that already had been shipped.——N. E. Brown, of Kellogg, Idaho, has examined and sampled a number of properties in this district recently. It is rumored that he is working for Bunker Hill & Sullivan interests.——The Outlander Silver Bar Co., which has been developing the Outlander group, 25 miles up the river, is packing out a trial shipment of 50 sacks of high-grade ore. The property is said to be showing up well, and it is expected that several consignments of ore will be shipped during next winter. The trail to the mine is bad, and at present it is possible to move ore only by pack-horses.

MEXICO

Durango.—It is believed that American geologists have discovered valuable coal deposits in the State of Durango; applications have been made for titles and concessions to explore them. Samples have been sent to the United States for analyses, which prove it to be of superior quality to that found in the coal region of the northern part of the State of Coahuila. The exact location is not made public, pending arrangements with the Secretary of Commerce and Industry for proper concessions to the original discoverers.

Guanacevi.—Arturo Lozoya has denounced several new properties on the Cruz ranch in the Guanacevi district from which he is extracting good gold-silver-lead ore. They are to be patented under the name of Ampliacion; they adjoin the Santa Cruz and El Carmen mines.——A group of silver mines is being taken up and developed by Antonio Soto in the mountains of the Hecho ranch near the old La Purisima mine. It is to be known as the Natalia.

Guanajuato.—All operations at the Asuncion del Monte mine has been suspended and a large number of miners are without employment. For some time past the mine has been worked on the 'buscones' system, the miners being permitted to work where and as they pleased being paid a proportion of the value of the ores extracted.

The Molino de Peregrina, the mill which has been treating the ores of this camp, has been shut-down and the local miners are obliged to suspend operations or send their ores to smelters at other points at a high freight-rate. Most of them have ceased production.

Inde.—Vicente Almazen, of Parral, has recorded two new locations with the mining agent at Inde. The properties are located in the Bufa mineral belt in this district. One consisting of 33 adjoining claims to be titled Albarradon and the other of two claims named La Heliopolis. The prospects give good indications of gold, silver, and lead ores.

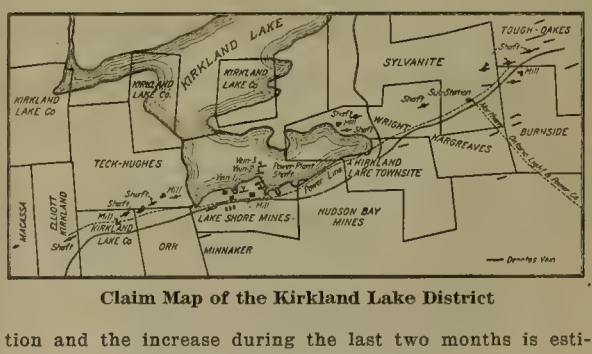
Epigmenio Navarro has begun development work on a number of new prospects in the Roca and La Casita mineral belts in the Inde camp. La Evolucion and La Risuena groups each are composed of several pertenencias.

Zacatecas.—The old Zacatecana mine, which was declared forfeited for failure to pay the taxes, has been relocated by J. I. Montes who has applied for titles under the new name of Los Risos de Oro. It is located near the Reina, San Miguel, Elisa, and Aurora mines. L. N. Miller has been appointed to make the survey and official maps.

ONTARIO

Cobalt.—The La Rose Consolidated has opened a promising vein of silver ore, 8 in. wide, in cross-cutting on the 570-ft. level of the Violet property. A vein found above it on the 370-ft. level, which is believed to be the same, is much narrower, but on being opened showed some high-grade ore.

Kirkland Lake.—This camp is steadily growing in importance. There has been a considerable influx of population and the increase during the last two months is estimated at from 30 to 45%. A large amount of new capital is finding investment in mining properties.



Claim Map of the Kirkland Lake District

At the Queen Lebel camp buildings are in course of erection and a plan for exploration and development has been outlined. A number of gold-bearing veins are in evidence.

Lightning River.—A number of important discoveries have been made in this area, lying south of Upper Abitibi lake, mostly on the property of the Lightning River Gold Mines. On the original claims of this company there are now three veins of outstanding importance.

Painkiller Lake.—Arrangements have been made to resume work at La Santa Lucia mine, which has been closed since the plant was destroyed by a brush fire five years ago. During previous operations a shaft had been put down 110 ft. and high-grade ore found in a 'pay-streak' ranging from a few inches up to 2 ft. wide. The company plans to salvage much of the machinery and sink the shaft to a depth of 300 feet.

Porcupine.—It is officially announced that new ore has been found on the seventh level of the Dome Mines, but in the light of present information its connection with the large orebodies on the tenth level is uncertain. The workings are being carried below the tenth level in connection with the extensive plan for exploration adopted, but the depth of the shaft has not been decided on.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Harvey S. Mudd is on his way to London.

Philip Wiseman is playing golf at Del Monte.

H. C. Perkins expects to go to Italy in November.

Charles H. White writes from Missoula, Montana.

Seeley W. Mudd is residing temporarily at Berkeley.

C. V. Corless sailed from Montreal for England on August 19.

Welton J. Crook is in Oregon examining deposits of iron ore.

Louis D. Hontoon has returned from Colorado to New York.

Willet G. Miller has been visiting the Sudbury district of Ontario.

A. H. Wethey, now a resident of Paris, was in New York recently.

A. W. Newberry has returned to New York from Cleveland, Ohio.

W. H. Emmons is here from Minneapolis, on his way to Manchuria.

A. H. Brooks, of the U. S. Geological Survey, is at Anchorage, Alaska.

Elmer M. Bray has moved from Los Angeles to Grantsville, Nevada.

A. C. H. Gerhardi is developing the Homestake claims on Alice Arm, B. C.

G. A. Swanquist has returned to Canon City, Colorado, from San Francisco.

J. Parke Channing has returned to New York from an inspection in Arizona.

W. S. Brainard, of New York, was recently at the Derry Ranch Dredging Co.'s mine, in Colorado.

George Otis Smith, Director of the U. S. Geological Survey, has returned from London to Washington.

Alexander Richardson, Principal of the Camborne School of Mines, in Cornwall, was in New York recently.

Robert F. Lafferty, manager for the Derry Ranch Dredging Co., of Leadville, Colorado, is at Sacramento.

Fred Cowans, general manager for the Utah Consolidated Mining Co., at Salt Lake City, was at Denver recently.

G. H. Dowell, general manager for the Phelps Dodge Corporation, has returned to Bisbee from a visit to the Mesabi Range.

Heath Steele was elected president of the Compañia Minera de Peñoles, in place of **K. B. Heberlein**, who has resigned.

J. S. Diller, of the U. S. Geological Survey, has completed his field-work in the Lassen Peak area and has returned to Washington.

H. Earl Havenor, geologist to the Tintic Standard company at Eureka, Utah, has resigned and will open an office at Salt Lake City.

John F. Sleeper has moved from Tenafly, New Jersey, to Santa Barbara, where he will establish a laboratory for chemical research.

J. Nelson Nevius has accepted a temporary appointment as instructor of geology in the California Institute of Technology at Pasadena.

Charles A. Banks, of the British Canadian Silver Corporation, has been visiting the Salmon River district, near the Portland Canal, B. C.

A. J. Underwood, manager for the Lluvia de Oro Gold Mining Co., at Lluvia de Oro, Chihuahua, Mexico, has been in California for a month.

H. Foster Bain, director of the U. S. Bureau of Mines, is expected at Salt Lake City on September 28. A banquet in his honor will be given by Utah mining men on September 29.

E. F. Birch, of Eureka, Utah, for the past twenty years manager of the various Knight properties in the Tintic district, has resigned. **Hugh Trenholm** will succeed him as manager.

Emmet D. Boyle, Governor of Nevada, announces that he will withdraw from politics at the expiration of his term, and resume the practice of his profession as mining engineer. He has entered into a partnership with **W. E. Hindrey**, with headquarters at Reno.

Obituary

W. B. Shackelford died at Chicago on July 9. In him the Tri-State zinc and lead region lost one of its leading and most helpful citizens. Recognized as the dean of the zinc operators, Mr. Shackelford had had long experience in this region, and the knowledge thus gained, supplemented with a natural ability to understand men and get to the heart of things, made his assistance in organization work particularly valuable. He was a member of the American Zinc Institute and in the early months of its existence gave much of his personal time and attention to its growth and development. Kindly of heart, broad of vision, he knew personally most of the employees of the companies he managed, and it is an eloquent tribute to his memory that nowhere will sadness over his death be more poignant than among these workers. Always taking an active interest in the welfare of his employees, he was one of the originators and one of the first presidents of the Southwest Missouri Mine, Safety, and Sanitation Association, which had its headquarters at Webb City. Later he helped to found the Oklahoma-Kansas-Missouri Safety and Sanitation Association, which ultimately became the Tri-State branch of the American Zinc Institute, with headquarters at Picher, Oklahoma. He was born at Rockville, Indiana, in 1862; he was married to Luela Richt, of Platte City, Missouri, in 1889. He was not an old man, but his death after months of suffering from a dangerous malady was not unexpected.

Anthony F. Lucas died at his home in Washington on September 2. Captain Lucas, as he was generally known, achieved fame twenty years ago by sinking the oil-well that became the Beaumont gusher of 1901, thereby starting the Spindle Top oilfield of Texas. He was born at Trieste, Austria, in 1855, and came to the United States in 1879. In our issue of December 22, 1917, will be found an interview covering his career, which was marked by great energy, keen intelligence, and unswerving integrity. In youth he was an officer in the Austrian navy, but, being a Dalmatian by birth and of pure Montenegrin descent, he took an early opportunity of leaving an uncongenial service in order to join an uncle in the United States. In 1885 he became an American citizen, and throughout his subsequent career he proved himself one of the highest type. His son served with distinction in the A. E. F. during the recent war. Captain Lucas was a man rich in enthusiasm for right ideas; he was a hard worker and an intrepid pioneer of industry, particularly in the development of the salt and oil deposits of the Gulf region, in Louisiana first and then in Texas; also in Mexico, where he was associated with Sir Wheetman Pearson, now Lord Cowdray, in the development of the Tampico oilfield. He traveled widely and was an unusually well-informed man. Of a cheery and kind disposition, bubbling over with good-nature and high spirits, he was beloved by a host of friends, who now mourn his sudden death. In him 'Americanization', a much abused term, found fitting expression; he was a good citizen, a loyal friend, a kind father, and a devoted husband.

T. A. R.

THE METAL MARKET

METAL PRICES

San Francisco, September 13

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25
Lead, pig, cents per pound	4.85— 5.85
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

September 12.—Copper is quiet and stronger. Lead is quiet and higher. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 6	63.62	39.12	Aug. 1	61.66	39.05
" 7	63.87	38.87	" 8	61.46	38.62
" 8	63.75	38.87	" 15	60.81	37.02
" 9	63.75	39.00	" 22	61.78	38.20
" 10	64.25	39.00	" 29	62.10	38.10
" 11 Sunday			Sept. 5	62.50	38.10
" 12	64.50	39.00	" 12	63.96	38.98

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59 33	Oct.	119.10	83.48	....
May	107.23	102.69	59 90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Sept. 6	11.75	Aug. 1	12.04
" 7	11.87	" 8	11.75
" 8	12.00	" 15	11.75
" 9	12.00	" 22	11.75
" 10	12.00	" 29	11.58
" 11 Sunday		Sept. 5	11.72
" 12	12.00	" 12	11.94

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 6	4.50	Aug. 1	4.40
" 7	4.50	" 8	4.40
" 8	4.50	" 15	4.40
" 9	4.60	" 22	4.40
" 10	4.60	" 29	4.40
" 11 Sunday		Sept. 5	4.44
" 12	4.60	" 12	4.55

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Sept. 6	4.70	Aug. 1	4.75
" 7	4.70	" 8	4.70
" 8	4.70	" 15	4.72
" 9	4.70	" 22	4.70
" 10	4.70	" 29	4.65
" 11 Sunday		Sept. 5	4.67
" 12	4.70	" 12	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Aug.	29	47.50
Aug.	16 47.50	Sept.	6	47.50
"	23 47.50	"	13	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

MR. FORD'S 'RAILROAD MIRACLE'

The 'railroad miracle' which Henry Ford is supposed to have wrought by converting, within a few months, the Detroit, Toledo & Ironton from a deficit-incurring property to a profit-earning railroad has been due, according to the current issue of the 'Railway Age', not to any change in method of operation but primarily to an increase in the average freight-rate per ton per mile.

During the four months September to December 1920, inclusive, after the present railway rates were fixed, the D. T. & I. handled an average of 49,246,000 ton-miles of revenue freight per month and had freight earnings averaging $493,800 per month. In the months of April, May, and June 1921 the road handled an average freight business of 37,093,000 ton-miles per month and earned from it an average of $694,203 per month. In other words, its average freight business in these three months was almost 25% less than in the last four months of 1920, while its average monthly freight earnings were over 40% greater.

This large increase in freight earnings, in spite of a big decline in the total freight handled, could have been due to only one cause, and that was an increase in the average rate. And there was a very extraordinary increase in its average rate per ton per mile—a thing to which public attention never has been called before. In the last four months of 1920 its average rate was one cent per ton per mile. The average rate per ton per mile in April, May, and June 1920 was 1.88c., 88% greater than in September, October, November, and December 1920. The average rate of all the railways in the country is only 1.23c.

To what was this remarkable increase in the average rate per ton per mile due? Chiefly to two things: First, to a great change in the character of the traffic handled. Mr. Ford began giving his railway practically all of his freight business; and the freight handled directly and indirectly for his motor-works consists largely of relatively high-grade commodities which pay a rate much higher than the average. Meantime, the amount of coal handled by the railroad greatly decreased. Coal being a bulky and cheap commodity, it pays a rate much smaller than the average. This change in the character of the traffic alone would have caused a large increase in the railway's average rate.

Secondly, the D. T. & I. has been able to use a large volume of traffic originated by the Ford interests to secure larger divisions of the through rates on all traffic hauled partly over its line and partly over other railways, and the great bulk of the D. T. & I.'s business consists of this through traffic. Both the change in the character of the traffic and the larger divisions of the through rates obtained by the D. T. & I. have tended to increase its average rate per ton per mile, and the only really great change which has been made on the D. T. & I. up to July 1 was in the conditions which determined its average rate per ton per mile.

But how about the reduction of 20% in its local rates and the advance in the wages of its employees which were so widely advertised? Neither of these went into effect until July 1 or later, and therefore neither of them had anything whatever to do with the increase in the railway's net earnings which have been so widely exploited. We shall have to get later data than are now available before anybody can say what is the effect of these changes in important policies.

MONEY AND EXCHANGE

Foreign quotations on September 12 are as follows:

Sterling, dollars:	Cable	3.73⅝
	Demand	3.74½
Franc, cents:	Cable	7.28
	Demand	7.30
Lira, cents:	Demand	4.33
Mark, cents		0.96

Eastern Metal Market

New York, September 7.

The general buying power has changed little; prices are in some cases stronger. The Labor Day holidays have also had their effect.

The elimination of most of the cheap copper has strengthened the market. Inquiry is good but buying not heavy.

The tin market is firm with moderate buying.

Prices of lead have been advanced; buying is steady.

The zinc market is stronger but demand is not heavy.

Antimony is unchanged.

IRON AND STEEL

An upward turn in output, after nine months of steady decline, is shown in the pig-iron statistics for August. The total was 954,193 tons, or 30,780 tons per day, against 864,555 tons in July, or 27,889 tons per day. Taken in connection with the larger buying of mid-August and the firmer tendency of prices, this increase in output confirms what has been said recently of a slight improvement in consumption.

While there was a net gain of but one furnace last month, the larger yield being due to the operation of many stacks at a better rate than in July, the outlook is for further improvement in September. Seven furnaces have either started since the first of the month or are scheduled to start before September 15.

The capacity of the 70 furnaces in blast as the month came in was 30,770 tons per day, against 28,175 tons per day for 69 furnaces on August 1, based on their performance in July. The gain of one furnace followed the loss of no less than 250 furnaces from the active list in the preceding nine months.

The slight upturn from the long decline in pig-iron prices made consumers cautious. Buying has been less active in the past fortnight; at the same time considerable inquiry is up and the balance between supply and demand is being closely watched in view of the starting of a furnace here and there.

COPPER

The tone of the market has improved perceptibly. Prices are firmer and there are less offerings of low-priced lots. This is due to the turn of the month and is analogous to the situation which has prevailed in the last two or three months. At the end of each month there have been offerings of weakly held lots which have caused prices to ease off at the close of each month, followed by a firmer market at the beginning of the new month. Electrolytic copper cannot be bought at less than 11.75c., New York, or 12c., delivered, for early delivery with most large consumers out of the market at this level or refusing to entertain less than 12.25c., delivered. Inquiries are moderately brisk and a better buying market is anticipated as the month progresses.

TIN

The market continues moderately active with prices tending higher. The London market continues strong and higher with prices about £5 per ton higher yesterday than a week ago; the market on this side is also advancing. Spot Straits, New York, was quoted at 27.25c. yesterday or 1c. per pound higher than a week ago, while spot standard in London was £16 15s. yesterday, future standard at £163 15s., and spot Straits at £162 per ton. Buying in the past week was moderately brisk on one day with dullness characterizing most of the other days. This was on Thursday, September 1, when the monthly tin statistics revealed a larger delivery into consumption than was expected. About 300 tons was sold to two or three dealers on that day. At the close of the day there were more sellers than buyers and since then the market has been quiet because of the holiday. Deliveries into consumption in August were 3320 tons with 1761 in stocks and landing on August 31. Imports in the first 8 months of this year have been 12,978 tons against 36,688 tons to September 1, 1920.

LEAD

Last Friday, September 12, the American Smelting & Refining Co. advanced its price 10 points to 4.50c., New York and St. Louis, and this was followed by independent interests except that the latter quote 4.30 to 4.35c., St. Louis. The market is firm and there is a quiet steady demand. There is also some demand for future lead and sales for this position have been fairly good at premiums over the above prices of $2 to $3 per ton.

ZINC

The disappearance of the weaker offerings has resulted in a firmer market. Prime Western cannot be bought at less than 4.20c., St. Louis, or 4.70c., New York, for early delivery as against 4.12½c., St. Louis, a week ago. Demand has not improved so far as buying is concerned though there is a little business each day. The better tone pervading all the markets and business in general is having some effect in this case.

ANTIMONY

The market is dull and unchanged with wholesale lots for early delivery quoted at 4.50c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, in wholesale lots for early delivery is quoted at 24.50c., f.o.b. plant, while importers are asking 19 to 20c., New York, for the same grade.

ORES

Tungsten: There is no life to the market and quotations are nominally unchanged at $3, and up, per unit in regular concentrate.

Ferro-tungsten is inactive with quotations for the American alloy nominal and the imported product quoted at 36.50 to 40c. per pound of contained tungsten.

Molybdenum: There is no activity and quotations are unchanged at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: Foreign high-grade ore can be bought as low as the nominal quotation of 20c. per unit, seaboard, but there is no demand.

Manganese-Iron Alloys: German ferro-manganese, 76 to 80%, is quoted at 4930 marks per ton, seaboard, which is at least $5 per ton less than the British product at $65, seaboard. Demand is light and the only sale noted is one of 50 tons of domestic alloy, quoted at $70, delivered. Two carloads of spiegeleisen are reported sold at $26, furnace, for 20% alloy.

Production of crude-oil in Mexican fields for the first two weeks of August was 4,519,000 bbl., according to a recent report. Estimates for the entire month are an output of 8,000,000 bbl. This production compares favorably with that of July, the first month in which shipments were drastically curtailed. July output was in excess of 300,000 bbl per day, about 50% below the normal average for the first six months of the year. Peak average production was reached in May, 560,000 bbl. per day. Oil in storage in Mexico has increased materially. Oil men will venture no estimate of the amount of oil in storage, but the capacity is now considerably in excess of 50,000,000 barrels.

Book Reviews

The Metallurgy of the Common Metals. By L. S. Austin. John Wiley & Sons, Inc., New York. 615 pp., ill. For sale by the 'Mining and Scientific Press'. Price, $7.

This is the fifth edition of a treatise that was first produced in 1907, and is devoted to a description of processes for the recovery and purification of the common metals, which in this case comprise gold, silver, iron and steel, copper, lead, and zinc. The metallurgy of iron is treated only to the point where pig-iron is produced. Since 1913, the date of issue of the last edition, radical changes have been made in metallurgical practice; the present edition has been re-written to a large extent to bring it up to date. The chapters dealing with gold and silver were written by Mr. M. W. von Bernewitz, and the chapter on zinc by Mr. R. G. Hall. Under the subject of general metallurgy the following topics are treated; ores and metals; fuels; refractories; preparation of ores; crushing, grinding, screening and classifying; metallurgical furnaces; combustion; metallurgical thermo-chemistry; roasting; concentrating of ores as a subsidiary operation in metallurgy. The discussion on 'gold' includes: gold ores and classification for milling; amalgamation; hydro-metallurgy of gold ores; chlorination of gold ores; cyanidation of gold ores; typical gold-mill practice; treatment of concentrate; various treatments and calculations; smelting gold ores. The treatment of the subject of silver includes silver ores and their occurrence; the amalgamation of silver ores; silver milling in hydro-metallurgical practice; cyanidation of silver ores; parting gold-silver bullion. There is a chapter on iron ores and their smelting, and another on wrought iron and steel. The treatment of copper includes a discussion of copper ores; blast-furnace smelting of sulphide ores; reverberatory smelting; converting copper matte; the hydro-metallurgy of copper; the refining of blister copper; and electrolytic copper refining. A chapter on the properties of lead and its ores is followed by others on silver-lead smelting; products of the blast-furnace; production of lead ores and prices; refining of lead and base bullion. Under the subject of zinc there are chapters on roasting zinc ores, the smelting of zinc ores, and zinc refining. The concluding chapters of the book deal with plant, equipment, costs, and the business of metallurgy.

The distribution of wealth in the United States is considered as a preliminary to a study of the economics of engineering. The labor situation is discussed, with particular reference to the mining industry. The tyrannical power of labor unions is emphasized. Figures are given to show that a financial crisis may be expected in the United States either in 1926 or in 1927. It is suggested that the mining, smelting, and milling industries should unite to form a union; an executive committee would outline a form of propaganda. Such an association should use the lock-out judiciously and should prepare for the shut-down. Even as the union man will strike and starve to gain his end, the author says, so must the company do, confident that by such lock-outs a permanent improvement can be made.

Under the title of 'Organization and Operating', Professor Austin deals with the organization of a metallurgical company. The divisions of the administrative department are given, and the scope of each is detailed. The duties of the various officials in the operating department are defined; and a list of 'Rules of Work' is appended. Plant operation and the morale of inside men are considered, followed by an analysis of the various modes of payment in vogue. The financial aspect of the matter is dealt with under 'Capital Requirements', which is followed by an analysis of the work of the accounting department. The subject of profit and loss is considered in the final chapter. The book covers a wide field and contains much that is not found in other treatises on the subject.

Concentration by Flotation. Compiled and edited by T. A. Rickard. 6 by 9 in., cloth, 692 pp. John Wiley & Sons, Inc., New York. For sale by the 'Mining and Scientfic Press. Price $7.

The American engineer is particularly favored in the wealth of information given by the technical journals of this country. The rapid development of our technical industries has been largely facilitated by the free interchange of methods and ideas. The editor of a technical journal renders a great service to his fellows when he persuades investigators and operating engineers to place the results of their work before the world promptly through the technical press. He renders a second and very vital service when he collects, edits, and publishes in compact and readily consultable form the papers that give a comprehensive view of the latest developments of any branch of engineering.

The flotation process of concentrating ores has had a phenomenally rapid and important development. The whole mining world is indebted to T. A. Rickard, as to no other individual, for keeping the public informed as to the development, perfection, and application of this valuable process. Mr. Rickard has written much upon flotation himself, and has persuaded many of the engineers engaged in the development and application of the flotation process to describe the results of their work in the columns of the 'Mining and Scientific Press'. He has published two previous compilations under the titles of 'The Flotation Process' and 'Flotation'. These were issued by the 'Mining and Scientific Press' and the editions are now exhausted. The present volume is a compilation of articles appearing in the 'Mining and Scientific Press' during the years from 1915 to 1920, and includes, in addition to articles re-printed in the previous volumes, eighteen articles that have appeared since the publication of the later of the two earlier compilations.

'Concentration by Flotation' will be useful to all who are interested in the most modern work in concentration, as it contains a glossary of the terms used in flotation literature, a history of the development of the process, a discussion of the extensive patent litigation accompanying the introduction of the process, together with numerous articles on the physical and chemical principles involved in flotation concentration, descriptions of the numerous applications of the process to the treatment of different types of ores, and detailed instructions for testing ores by flotation. The gathering together of these many articles into a single volume makes them readily available for use by the teacher, the student, and the operating engineer. In the course of time we may expect Mr. Rickard to persuade others to contribute further to our knowledge of the technique and theory of flotation concentration, and again gather together a book bringing the subject up to some later stage of development. At the present, 'Concentration by Flotation' contains more valuable information on this subject than is presented in any other single volume.—J. M. H.

The Handbook of Standard Details. By C. H. Hughes. Pp. 312, illus. D. Appleton & Co., New York. For sale by the 'Mining and Scientific Press'. Price, $6.

This book was compiled especially for engineers and draughtsmen, so that drawings, tables, and formulae of standard details might be available in convenient form. All who are in any way interested in the subject, and this includes all mining engineers, will find it invaluable. The contents are as follows: Drawings; Fastenings; Power Transmission; Pipe, Tubes, and Fittings; Rope and Chain Fittings; Miscellaneous Details; Structural Details; Useful Tables.

Company Reports

LUCKY TIGER COMBINATION GOLD MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mills at El Tigre, Sonora, Mexico.

Operating Officials: R. T. Mishler, manager; E. J. Stanley, mine superintendent; W. A. Wasley, mill superintendent.

Financial: Concentrate sales, $3,405,489.96; operating costs, $1,870,011.30; general income, $58.875; general expenses, $107,376.59; net realization from operations, $1,486,981.47; consolidated net profit, $792,201.76; dividends, $1,323,373.45; to date, $7,469,572.89.

Development: 11,218 feet.

Production: 76,212 tons was milled, producing 6746 tons of concentrate, assaying 2.78 oz. gold, 433.31 oz. silver, 3.9% copper, and 14.05% lead. The extraction by concentration amounted to 96%, as compared with 94.2% during the previous year.

General: Increased efficiency is shown in the mining work, the output per man-shift having increased from 0.45 ton in 1919 to 0.64 ton in 1920. The increasing amount of zinc in the ore constitutes a metallurgical problem. It renders the ore less desirable for smelting and has been the cause of repeated increases in the smelting charges. The removal of the zinc at El Tigre by electrolytic methods is rendered difficult by the high cost of power and the low price of zinc. Experiments are being continued in the hope of solving the problem.

MINING CORPORATION OF CANADA, LTD.

Report for the year ended December 31, 1920.

Property: Mines, mills, and cyanide plant in Canada; owns the Cobalt Reduction Company.

Operating Officials: C. E. Watson, manager; M. F. Fairlie, mill manager.

Financial: Gross income, $1,693,065.47; total cost, $1,041,603.74; surplus as at December 31, 1920, $3,268,628.53; dividends paid during the year, $622,518.75.

Development: Ore-reserves, 103,603 tons containing 2,181,000 oz. silver.

Production: 51,918 tons milled for a production of 1,664,018 oz. silver as compared with 1,230,653 oz. during the previous year.

General: Active search was made during the year for new properties; three hundred received consideration, of which, in the case of 165, permanent records were prepared. The purchase of the Buffalo mine was completed. The corporation owns a large interest in the syndicate having under option the Flin Flon property.

GUANAJUATO REDUCTIÓN & MINES COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill at Guanajuato, Mexico.

Operating Officials: H. P. Smith, general manager; A. McDonald, mill superintendent.

Financial: Receipts, $1,478,053.85; disbursements, $1,490,455.65; deficit for the year, including bond interest, $58,794.74.

Development: 5935 metres of new levels and raises driven in the Mother Vein mines. Ore-reserves amount to 233,145 tons of mine-ore blocked-out, with 219 grammes silver and 2.55 gm. gold per ton; and 483,143 tons of ore on dumps, with 158 gm. silver and 1.20 gm. gold per ton.

Production: Tonnage milled, 217,074; production, 35,618.95 kilogrammes of silver and 431,154,614 gm. gold.

General: A further reduction in cyaniding costs was made at the Flores plant, the expense being $1.0909 per ton, as compared with $1.2029 in 1919.

NEW YORK & HONDURAS ROSARIO MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mine and mill in Honduras.

Operating Official: A. R. Gordon, general manager.

Financial: Operating income, $1,511,735.01; operating expenses, $1,125,196.19; operating profit, $386,538.82; New York administrative expenses, $67,498.26; balance carried to surplus, $211,667.54; surplus as at December 31, 1920, $1,403,204.39; dividend, $320,000; amortization, $80,000; dividends and amortization to date, $5,790,000.

Development: 16,838 ft.; ore-reserves, 211,783 tons containing 16.32 oz. silver and 0.067 oz. gold.

Production: 140,100 tons was treated for a return of 1,711,349 oz. silver and 8001 oz. gold; average silver recovery was 86.07%; gold recovery, 94.52%.

General: Tests made with the idea of introducing flotation have been unsuccessful. A new Dorr thickener was erected during the year.

SILVER KING COALITION MINES COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill in Utah.

Operating Officials: M. J. Darley, manager; Forrest Mathez, superintendent.

Financial: Total income, $1,056,041.55; expenses, $644,952.15; net profit to surplus, $358,359.61.

Development: 8974 feet.

Production: 14,517 tons of first-class ore, sold for $807,862.24; 25,103 tons of second-class ore, producing 4568 tons of concentrate that was sold for $198,825.03; 1849 tons of lessees' ore sold for $116,957.88, producing royalty amounting to $36,723.92.

General: A new flotation unit of 100 tons capacity was constructed and almost completed when fire occurred early this year, destroying the entire plant. It has since been decided to replace the mill with one of a capacity of 450 tons per day.

ROUND MOUNTAIN MINING COMPANY

Report for the year ended December 31, 1920.

Property: Mines and mill in Nevada.

Operating Official: Gibson Berry, general superintendent.

Financial: Total revenue, $106,922.74; total operating costs, $122,855.52; net operating deficit, $15,932.78.

Development: Round Mountain Mining Co., 2006 ft.; by lessees, 2139 feet.

Production: placer operations, 64,665 cu. yd. gravel was hydraulicked for a recovery of $56,277.37; lode and lode-leasing operations, 4513 tons was mined and milled for a yield of $21,377.96.

General: It is stated that during 1921 the debts of the company will be greatly reduced if not entirely liquidated. Most of the difficulties have been surmounted; conditions are more favorable for gold mining, as far as the company is concerned, than has been the case for many years.

GREENE CANANEA COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mines and plants in northern Mexico.

Operating Official: T. Evans, general superintendent.

Financial: Income, $7,299,918.84; expenses, $6,380,344.67; balance, $560,078.50; dividends, $1,000,000.

Development: 76,431 feet.

Production: 1,053,806 tons of wet ore was produced; the yield amounted to 43,672,939 lb. copper, 1,778,617.56 oz. silver, and 10,089.584 oz. gold.

General: Since the introduction of flotation at Cananea it has become evident that the flow-sheet can be simplified and cost of concentrating reduced. Plans are being prepared for the necessary changes.

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THE LARGEST PRODUCER OF OXYGEN IN THE WORLD

L-506-21

T. A. RICKARD, • • • • Editor

ANOTHER technical society has been formed and is gaining a representative membership. We refer to the Society of Economic Geologists, of which Mr. J. Volney Lewis is secretary, with Mr. R. A. F. Penrose as president and Mr. Edson S. Bastin as vice-president. The economic geologists are a scholarly and widely-traveled group of men; they should be able to establish a useful and interesting association.

WE have received a letter from a subscriber asking whether a certain process would suit his ore, which, according to wet assays, contains gold and platinum, but which yields no precious metal when subjected to the fire-assay. This is an old story; in this case, as in others, it indicates chicanery, fakery, spoofery, trickery—in short, lying for a purpose. If an ore yield no gold or platinum by fire, and if the assay be made by a competent person, it may be taken for granted that it is not an ore in the technical sense, that is, it cannot be exploited at a profit for gold and platinum, because we know of no mineral containing these elements that will not surrender its valuable contents when treated with flux and fire under conditions that have proved sufficiently effective in the past.

DISCUSSION this week starts with a letter from Mr. Walter X. Osborn, who writes from Arizona to protest against the excessive price of articles made of brass. It is to be hoped that the newly organized Copper and Brass Research Association will take note of this. The purpose of the Association, of which the principal copper operators are members, is to stimulate the use of copper and brass. One way to do so is to prevent the imposition of extortionate prices on articles manufactured of copper and brass. Mr. Leon A. Perret writes from Yokohama on the subject of black sand, that is, the treatment of the heavy concentrate obtained in the course of placer mining. His suggestion to use the Berdan pan reminds us of the days when that little grinding machine was much in vogue in stamp-mills, for the treatment of the heavy sand and pyrite saved on blankets. Another criticism of the proposed revision of the mining law comes next, from Mr. A. G. Blackburn. A tunnel-driving record is claimed for the Hetch Hetchy engineering project by Mr. F. C. Hickman. From Queensland we have received a letter on the use of producer-gas; the writer, Mr. Erle Huntley, a well-known mining engineer, sends a useful drawing of a gas-producer that has proved efficient. Another letter on the mining law comes from Mr. Gordon D. Stanley. He also joins with other prospectors in objecting to sundry of the proposed changes. We would like to hear from those who approve of the revision.

THE influence exerted on the magnetic needle by black iron sand was discovered by Mr. Arthur Gibson during the winter of 1905, on the Third Beach near Nome, in Alaska. The increased magnetic variation in the horizontal plane as indicated by a transit-compass when placed over the paystreak was pronounced, and this led him to make a closer investigation. The depth from the surface to the paystreak varied from 25 to 130 feet, and all the overburden was frozen. The common dip-needle held in the hand gave better results than the transit-compass; it was realized that sensitive instruments were needed; two were constructed, one of Mr. Gibson's design. Later, in 1910, it was learned that the Canadian government had been using magnetometers with success in tracing and defining deposits of iron ore, so he sent to Europe for two more instruments, known as the Thalèn Tiberg and Thomson-Thalèn models; the latter is so sensitive that it will indicate the approach as well as the direction of travel of a street-car that is three city blocks distant from the instrument. On another page of this issue will be found an interesting article by Mr. Gibson, who has familiarized himself with the instruments and their application, and now publishes a valuable contribution to the literature of the subject.

'BUY something made of copper.' To this slogan a recent special issue of the 'El Paso Times' is devoted. A circle drawn through Santa Rita on the east, Jerome on the north, Ajo on the west, and Cananea on the south would include copper mines that produce, in normal times, 60,000,000 pounds of copper per month, which is nearly half of the total output of the United States. The entire territory is largely tributary to El Paso, and although the city is by no means dependent upon mining, that industry is the most important of the surrounding region. A 16-page supplement is composed of articles by prominent engineers engaged with the copper-mining companies in New Mexico, Arizona, and Sonora; among them is an interesting his-

torical article, 'The Romance of Copper Mining', by Mr. John M. Sully, general manager for the Chino Copper Company, at Santa Rita in New Mexico. He describes the first production of copper in New Mexico, 114 years ago. Advertisements of progressive business firms of El Paso accompany the articles; one of them is the Mine & Smelter Supply Company, with whom originated the slogan—practical if not poetic—'Buy something made of copper'.

THE Utah Copper Company finds itself in a peculiar predicament in consequence of the clause in the Federal Railroad Act that requires every railroad company in a particular district to contribute, to a Federal fund, half of its profit in excess of an amount sufficient to yield a return of 6% on its investment. The company owns all the stock of the Bingham & Garfield Railroad Company, over whose line the ore from the mine at Bingham is transported to the concentrators at Garfield. It financed the building of the road; the separate company to operate the railroad was incorporated in order to gain certain conveniences and advantages in the matter of taxation that could not be obtained if the mining company were the nominal as well as the actual owner of the railroad. The railroad company charges the mining company for hauling ore, the profit being paid back to the mining company in the form of dividends. The mining company includes in its annual report the financial statement of the railroad company, and the whole proceeding is a matter of book-keeping. The railroad company became a prosperous corporation; so prosperous in fact that its officials looked with natural distaste at the provisions of the Railroad Act to which we have alluded. Legal strategists were called into consultation, and a contract between the two corporations was signed, whereby the Utah Copper Company obtained the privilege of using the Bingham & Garfield railroad, in consideration of which the mining company undertook to guarantee the railroad company a net return of 6% on its investment, thereby avoiding the possibility of the railroad company being obliged to disburse good money for the support of less profitable railroads in the Western district. Now the Public Utilities Commission of Utah and the Federal Interstate Commerce Commission have undertaken an investigation to determine whether the terms of this contract violate the law.

IN the course of his address on 'Earthquake Engineering', before the Engineers Club of San Francisco, Professor Bailey Willis of Stanford University made a plea for public support in behalf of a proposed appropriation of $15,000 annually for five years for the U. S. Coast and Geodetic Survey, this money to be used for repeating the observations of the primary triangulation on this coast with a view to measuring the displacement of the surface that is caused by seismic tremors. He made the interesting statement that scientific observations along a particular parallel of latitude around the earth had proved that Ukiah, for example, was moving north at the rate of about one metre per annum, this being the measure of the displacement along a rift parallel with that which marked the line of the great earthquake of 1906. Earth tremors are due to slippage along a shear-plane at such times as the stress, attributable to the pressure of the sub-oceanic mass against the continental margin, overcomes the friction between the two faces of rock. A major shock, or earthquake proper, usually follows a series of smaller tremors, and marks the culmination of an effort to restore equilibrium—the balance of nature. The Seismological Society of America, of which Dr. Willis is president, is about to issue an engineering bulletin accompanied by a map of the State, showing the principal rifts or faults, in order that the people in general and the engineers in particular may be able to avoid them, especially in selecting sites for buildings or other engineering structures. Along any of these rifts or lines of quake there is danger of further movement; also in 'made' ground near-by, which, during an earthquake, will tremble like a bowl of jelly, because the looser the texture the greater the vibration. It is hoped, by the adaptation of the instruments developed during the War for the detection of the movement of submarines and of marching armies, to be able to obtain a complete record of local tremblings, the growing intensity of which is regarded as the precursor of a bigger shake. Thus it may be possible eventually not only to predict the place but also the time of earthquakes, so that human beings may take steps to escape the ill effects of them.

Copper

The higher quotations for the shares of copper-mining companies indicate the growth of confidence that the period of idleness will come to an end soon. Moreover, it is recognized generally that, owing to the recent curtailment of production, the technical position of the market for copper is improving. In July the output of our domestic mines was 16,390,000 pounds, and of American mines abroad—all of which send their copper to the New York market—23,145,000, making a total of 39,535,000 pounds. The August output is estimated at about the same. Sales during the month are known to have amounted to 70,000,000 pounds. The normal production is about 145,000,000 pounds. For the first seven months of this year the production is estimated to have been 700,000,000; for the remaining five months it is expected to be 200,000,000, making the total 900,000,000 for the current year. Domestic consumption and exports for the first seven months averaged 98,719,000 pounds, or a total of 691,033,920. Assuming the same rate for the next five months, the total for the year could be placed at about 1,175,000,000 pounds. Thus the consumption would exceed the production by 275,000,000 pounds. Shipments abroad during the seven months totaled 331,033,920 pounds, but domestic consumption was low, averaging only 51,428,000 per month. The stock of refined copper in this country on January 1 of this year was estimated at 650,000,000 pounds, and the total

supply available during the current year may be taken at 1,659,000,000 pounds. Therefore the stock of unsold copper at the end of this year should be not more than 384,000,000 pounds. There is a great improvement in the statistical position. In consequence the copper-mining industry ought to start 1922 under excellent auspices. The supplies of scrap brass, cartridge-cases, shell-bands, and other residues from the War are becoming less abundant, and as they disappear there will come an increasing demand for new copper, especially from Europe. The industrial health of the United States is recovering from the depression that came so suddenly last November, and with the revival there will be a broader market for copper.

Institutes and Technical Journals

The latest issue of the 'Canadian Mining Journal' contains a valedictory from Mr. F. W. Gray on his retirement as editor. We have read it with sympathy, for it has a plaintive note. Mr. Gray asserts that it is no easy matter to conduct a national mining paper in Canada because the number of technical men is relatively small and they are scattered over a wide territory; moreover, the mining industry of Canada is small as compared, for example, with that of its big neighbor. He compliments the technical journals of the United States, having in mind, we hope, the mining papers; he says they are "excellent publications, backed by wealthy publishers, and, in recent years actuated by the consciousness of increasing importance in the world relations of the United States, the leading technical papers of that country have shown wide catholicity in their choice of matter, and have indeed taken the world for their parish". This is no small compliment, and in behalf of our contemporaries and of ourselves we thank our Canadian friend for it; but he is in error as to the backing of wealthy publishers. He might be correct if he omitted the 'Mining and Scientific Press', but we believe he did not mean to omit us, because more than once he has expressed a friendly appreciation of our efforts. No wealthy publisher has ever backed the 'M. & S. P.'; it has made its way on its own merits for 61 years. Mr. Gray says, "it is natural that Canadian publicists should avail themselves of the prestige and wide circulation of these American papers", but that makes it just so much harder for the 'Canadian Mining Journal' to obtain the requisite support from subscribers and literary contributors. In one respect, however, the Canadian paper has a slight financial advantage: it receives advertisements from the Dominion government and from the Mining Departments of the various Provinces. The issue before us contains three pages of such advertising. That is a small matter, however; it is poor solace for the inadequate support from the manufacturers of Canada. The apparent lack of success on the part of our Canadian contemporary is due, we venture to suggest, not so much to competition from this side as the trespass made upon its field of activity by the Canadian Mining Institute—which now has a longer name. The monthly bulletin of this society is a far more readable and more comprehensive publication than the 'Canadian Mining Journal'; it is more attractive and more interesting, and is sold to members at $1 per annum. The membership of the Institute includes a large part of the clientele that the 'Journal' desires, and among the contributors to the pages of the bulletin are the very men whom Mr. Gray, and his successor, would wish to co-opt. In short, we think that it is not the smallness of the Canadian mining industry, or the inability of the Canadian mining public to support a national paper, that has interfered with the success of the 'Journal', but the trespassing of the Institute upon the field of technical journalism. The Institute is doing excellent work as a publisher on its own account; its monthly bulletin contains a good summary of news from the various mining districts, besides editorial comment and special articles. It has usurped the principal function of a national mining paper. That is why the 'Journal' languishes. The question arises, does the Canadian mining industry gain from the expansion of the Institute's publishing activities when these compete unfairly with the 'Journal'. We say "unfairly" because the Institute primarily is not a publisher, and certainly was not intended to become the publisher of a mining periodical, but is an association for promoting the solidarity of the mining profession in Canada. The extension of its activities into journalism is due in large measure, we believe, to the initiative of its former secretary, Mr. H. Mortimer-Lamb, himself a man of scholarly attainments and wide human sympathy, qualities admirable in themselves but the exercise of which proved unfortunate for the editors of the 'Journal' because they lacked these qualities in equal measure and therefore were unable to meet the competition started by the secretary of the Institute. Its bulletin, of course, is a subsidized publication, that it to say, it is financed indirectly by the members of the Institute; it is not conducted purely on its merits as a commercial venture in journalism. It solicits advertising, and therefore cuts into the revenue that would otherwise come to the 'Journal'.

Let us accept the conditions as they are and assume that the issuance of the Institute's monthly bulletin will render it impracticable to conduct a profitable mining paper in Canada; is such a result desirable or is it deplorable? We ask this question not without a side glance at New York. The subject is one of timely interest and, we believe, of paramount importance. In London, the Institution of Mining and Metallurgy issues a monthly bulletin, but that publication contains no news items and no editorial comment; it is restricted to its proper function, and therefore does not compete with 'The Mining Magazine' or 'The Mining Journal'. It may be said of 'The Mining Magazine', at least, that it fulfills the purpose so well that it need not fear competition from the Institution's bulletin, but it is conceivable that if the latter were to be expanded into journalistic form it might trespass seriously upon the field of the 'Magazine'. The point is that such competition is unfair because these

journalistic activities of the engineering societies start with the advantage of a clientele won through other means, namely, the appeal to professional solidarity in behalf of a professional organization; not for the purpose of publishing a journal but for the purpose of publishing technical papers and more particularly for providing a public occasion at which these papers can be discussed. Now, we ask the members of the mining profession to face the issue squarely: is it to their advantage and to the advantage of the mining industry to approve of the journalistic exuberance of their institutes or institutions if this exuberance have the effect of killing independent journalism? It may be suggested that we need both the professional society and the technical journal each in its own particular field. The societies grew out of the professional spirit developed through the exchange of ideas in the mining journals, which have been their strongest supporters in the past; now the very existence of independent journalism is threatened by an invasion of their territory. The editors of the journals usually have abstained from professional practice, some of them consistently. Does the profession desire the continuance of professional journalism and independent editorial writing, or does it desire to place itself entirely, for good or ill, in the hands of a central committee? We dare to say that the profession and the industry in Canada, in Great Britain, or in the United States, will lose more by killing independent journalism than by limiting the activities of its professional organization, particularly those that seem to involve a surrender of its truly professional character for the sake of commercial gain.

The Inarticulate Subordinate

Reciprocity in the dissemination of interesting and useful information is recognized among mining engineers as one reason for technical efficiency, as well as for the avoidance of economic waste in the duplication of research and experimentation. A man who relies on his own experience and ideas can make little progress. In the current annual report of the St. John Del Rey Mining Company we note a continuation of the policy of obscuring the metallurgical work at the plant in an atmosphere of mystery. The mine is one of the most interesting, and has the deepest shaft in the world. The plan of metallurgical operations probably would be equally interesting if it were disclosed. The product is mainly gold; that much cannot be camouflaged. But when the interested engineer comes to a question of metallurgical practice he is tantalized by the lack of definite information and by vague references to the "first process" and the "second process". Attention is drawn in the report to a concentrating plant, and to "reconcentration strakes and furnaces"; the recovery from this, the "first process", it appears, "has amounted to 70.89% of the total content". In the "second process" it would seem that collecting and stirring-vats are used, but there is no hint of cyanidation; here the recovery of gold represents 20.08% of the total content. To increase the mystery, the assay-value of the ore is given in 'oitavos'; it is comparatively high-grade. The St. John Del Rey company has not lagged behind in making use of contemporary improvements in technical practice, most of which are available at a negligible cost because of the frank publication of details by those companies and individuals who favor reciprocity and who appreciate their obligations in this respect. The reticence observed by this particular corporation in regard to metallurgical details is not typical of the best English mining enterprise. Recently we made enquiry of Messrs. John Taylor & Sons for technical information concerning the metallurgical operations at one of their mines in India, and our request was met with a spirit of frankness and courtesy, which inspires confidence and encourages co-operation. A mining company should be the first to realize that its annual statements constitute a valuable means of publicity on technical as well as on financial matters; it would be better if the reports of the heads of the mining and metallurgical departments were incorporated therein, so that the reader could appreciate the personality behind the description of work and progress. Although in many instances this may be impracticable, we believe that the plan should be followed to a greater extent than it is. The general manager would be spared the responsibility of sponsoring absurd statements on technical matters on which he frequently possesses no specialized knowledge; we call to mind a report of this kind that came to hand recently and that dealt with a technical problem in a manner that was hopelessly misleading. The second advantage of allowing the superintendents of mine and mill to be heard would be that the statements of those in such responsible positions would begin to reach a wider audience. Initiative and effort would be encouraged if such officials knew that at the end of the year they were to be allowed to state the result in their own language. The publication of such reports would stimulate an appreciation for correct and convincing statement, for concise wording of matter that is of technical interest; it would encourage a desire to succeed, if not to excel. The obligation of the company toward such men does not end with the payment of salary. Higher education should be fostered, and one of the best means to do this is to stimulate adequate self-expression. The best technical book on a well-known subject is always the one that gives credit to those who have gone before, who have blazed the trail and are deserving of credit for pioneer work. This is the scientific spirit; its absence invariably marks a divergence from verisimilitude, if not from truth. The men in charge of mine and mill have 'done their bit' to bring the industry to the state of technical efficiency in which it is today; they should become articulate in the company reports of the year's operations. The general manager who can appreciate this will find that much credit reflects on him for an attitude that bespeaks an appreciation of the work of others, and of a desire for general advance, based on a recognition of the fact that the ability of the individual makes for the efficiency of the staff as a unit.

Cost of Copper Products

The Editor:

Sir—I recently received a quotation from one of the largest pump manufacturers, for a telescopic joint for a sinker pump. Their price for a 4-in. by 16-ft. joint, with galvanized inner and outer tube, is $200. With a brass inner tube, which is much superior, the price is $550. The weight of the brass inner tube is not over two hundred pounds, so that they are asking a dollar and a half per pound for the brass, as the cost of fabricating a brass tube is not any greater than fabricating an iron one.

This illustrates one of the principal reasons why the copper industry is dead and the principal mines are shut down. As long as manufacturers ask such unreasonable prices for articles made of copper or brass, we cannot hope to see the demand for copper increase very much. A firm dealing in mining machinery has started a campaign in El Paso to stimulate the demand for copper. They have a card printed, "Buy something made of copper", which they have displayed in a large number of the stores in El Paso. I believe they would accomplish more if they would use their influence with manufacturers to getting prices on copper and brass articles down to a point where they could compete with similar articles made of iron or cheaper metals.

WALTER X. OSBORN.

Gila Bend, Arizona, August 29.

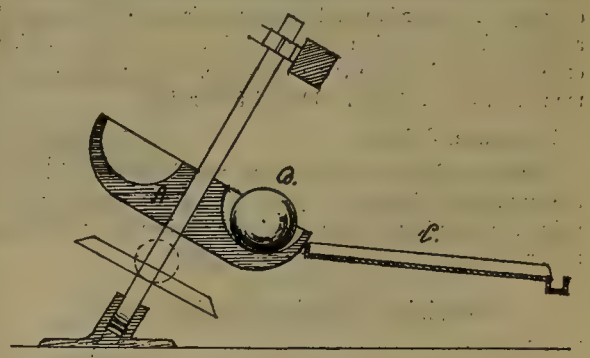
Gold in Black Sand

The Editor:

Sir—The discussion aroused by the interesting information given by Mr. John Gross in your issue of November 27, 1920, and of April 9, 1921, touches a question the importance of which seems not to be sufficiently recognized by the practical placer miner. In fact, a great amount of gold is discarded and lost in the large quantities of black sand that are thrown away daily in almost every locality where gold-placer mining is carried on, owing to the absence of a cheap and simple method of treatment for the clean-ups. Although the combined qauntities of black sand obtained on any goldfield is considerable the amount produced by the individual operator at each clean-up is small, and there lies the difficulty in devising a simple and cheap method of treatment without expensive and complicated equipment, such as a combination of classifiers, ball-mills, concentrators, electromagnetic separators, and the like.

Mr. Holmes, in your issue of May 14, is quite right in asking "Why classify before grinding?" As certified by the experiments of Mr. Taylor stated in your issue of June 18, and by the tests conducted by Messrs. Gross and Davis at the Alaskan station of the U. S. Bureau of Mines, the main feature for successful recovery of gold from black sand is the grinding of the clean-ups, and my own practical experience has led me to the same conclusion. Consequently it all comes to the use of a cheap and simple grinding appliance. Such a one is the Berdan pan, which some thirty years ago was an indispensable part of almost every stamp-battery in Australia and New Zealand. I venture to say that this device will solve the black-sand question, as it meets all the requirements of the case, doing the grinding and the amalgamation at the same time, and not requiring any particular attendance.

The accompanying sketch shows the equipment. The



BERDAN PAN

pan *A* and the ball *B* (about 12 in. diam.) are of ordinary cast-iron and can be made in any foundry. *C* is a copper-plated amalgamating-table. Mercury is used in the pan, which makes about 18 or 20 revolutions per minute. The incline of the shaft is about 60°. The driving gear is fixed beneath the pan to prevent oil and other greasy substances from interfering with the amalgamation. The pan requires about ½ hp., and that amount can always be taken from any steam-engine or electric motor at work on the mine. Should this not be possible there generally is a ditch or a flume that can supply the water necessary to drive the pan by a miniature overshot wheel. The cost of installation should not exceed a couple of hundred dollars, I suppose, and the device is simple enough to set up anywhere, even at the most remote placer mines of the interior of Alaska. It could be placed on any dredge. In working, one Berdan

pan can be used to treat the clean-ups of a great many placer mines, and the accounts with each individual black-sand producer could be settled in proportion to the volume, or the weight, of the material delivered for treatment, as in the same locality the gold content in the clean-ups is nearly constant, the nature of the gold being more or less uniform, the same methods of washing being used, and the panning being done with the same skill on all mines in the same district. The error in the accounts thus made should be very slight, I suppose, and this mode of procedure makes matters simpler than cleaning up the Berdan after each separate lot had been treated.

I have used the Berdan pan as described in a number of places in Russia, and in each instance it gave entire satisfaction. I have not the results at hand, but one case I remember distinctly, and that was on the Kolchan mines of the Orsk Goldfields, which at that time belonged to the Okhotsk company, in partnership with Messrs. Nadetzky and Stepanoff. During a visit to these mines in the autumn 1898 or '99, I advised the manager to install a Berdan pan for the treatment of the black sand, and gave him a sketch of it. A few months after the close of the next operating season I received a letter in which the manager thanked me for the good idea I had suggested, and informed me that the output of the mines had been a few pounds in excess of 40 poods (21,080 oz.) of gold. The Berdan had recovered from the black sand additional 28 Russian funts (367 oz.) of gold, which otherwise would have gone to waste. The whole equipment had cost between 400 and 500 rubles.

Yokohama, July 29. L. A. Perret.

[Stamp-mill and cyanide-plant metallurgists will find the apparatus described by Mr. Perret of considerable value for cleaning amalgam and for recovering gold from mill refuse and smelter slag.—Editor.]

Revision of the Mining Law

The Editor:

Sir—In your issue of June 18 you invite discussion of the proposed new mining law. Following are some objections of mine, approved by all the prospectors that I have discussed the matter with.

Section 5 is impracticable in that it cannot be made to apply to lands of the public survey. Speaking from experience, I would say that in large areas of the mountain States, survey stakes are almost as scare as gold mines. In the rough and most inacessible places they probably were never put out; in others they have been knocked down and destroyed by the elements and stock. I recall one instance, of four men, directed by a competent surveyor, working a week trying to find a corner to tie an application for patent, who failed to find one within six miles.

Article B is wrong, as it would enable persons or corporations to locate and hold, at trivial expense, large areas of the public lands for long periods of time without development. The mineral outcrops that smile at one as they are approached have approximately all been found. Most of the recent discoveries have been made in a trench or shaft dug with a pick.

Article E. A bad one: as it permits even a questionable discovery, made in a drill-hole, to be covered by a patent of 160 acres. Some claim! To us of the hills, it looks like an entail of the mining regions of the West to engineers and mining companies, and in lieu of encouragement to the prospector it would tend to drive him out of the game entirely.

Why not eliminate that part of the old apex act that is objectionable, and give us vertical side-lines? We would then have a law that has stood the test for half a century, with the kick knocked out of it.

A. G. Blackburn.

Masonic, California, August 26.

Tunnel-Driving Record

The Editor:

Sir—I read with great interest the article in your issue of the 27th ult. regarding the new world's record for shaft-sinking by the Walter Fitch Jr. Co. As I have done a good deal of sinking myself I think it was great work. I am driving a tunnel now, and I established what I think is a new U. S. record for hard-rock tunnel-driving last month, namely, 776 ft. in schist and quartzite. The work was done at Priest Portal, which is part of the Hetch Hetchy project on the mountain division. Dimensions 11 ft. 3 in. by 11 ft. 3 in. Area of heading 106 sq. ft. An average of 28.3 lb. of 40% gelatine powder was used per foot. Ingersoll-Rand Leyner machines were used, three machines on the bar, and the Myers-Whaley mucking machines were used. Worked three shifts per day, and during the month 38 hours were lost on account of repairs and power failures. Messrs. A. C. Dennis and Fred Wilson are sub-contractors.

F. C. Hickman.

Groveland, California, September 4.

Producer-Gas

The Editor:

Sir—A letter by M. W. von Bernewitz in your issue of March 19 prompts me to send you a description of a producer-gas plant that has been in operation for over six years at the works of the Hampden Cloncurry Copper Mines, in Queensland, Australia.

I can safely affirm that for over five years there has not been ten minutes stoppage of power due to defects in the producer or power installation. The plant runs 24 hours daily and 7 days per week.

The engine-plant consists of six engines of an average capacity of 250 brake horse-power each. These drive on a main-line shaft, the power from each driven pulley being transmitted thereto by a friction-clutch. Only four or five engines are used at one time, and, owing to the friction-clutch connection to the line-shaft, any engine can be laid by for overhaul at any time.

The gas-plant consists of three producers, each capable of making gas to develop 800 horse-power. Two of these, only, are used at one time. The fuel used is ordinary cord-wood, cut in 6-ft. lengths, and fed direct to the producer in all kinds of shapes and sizes. The consumption of fuel over some years has averaged 2.2 lb. per hp-hour, or, say, three pounds per kilowatt; and this weight takes the bark and chips into consideration.

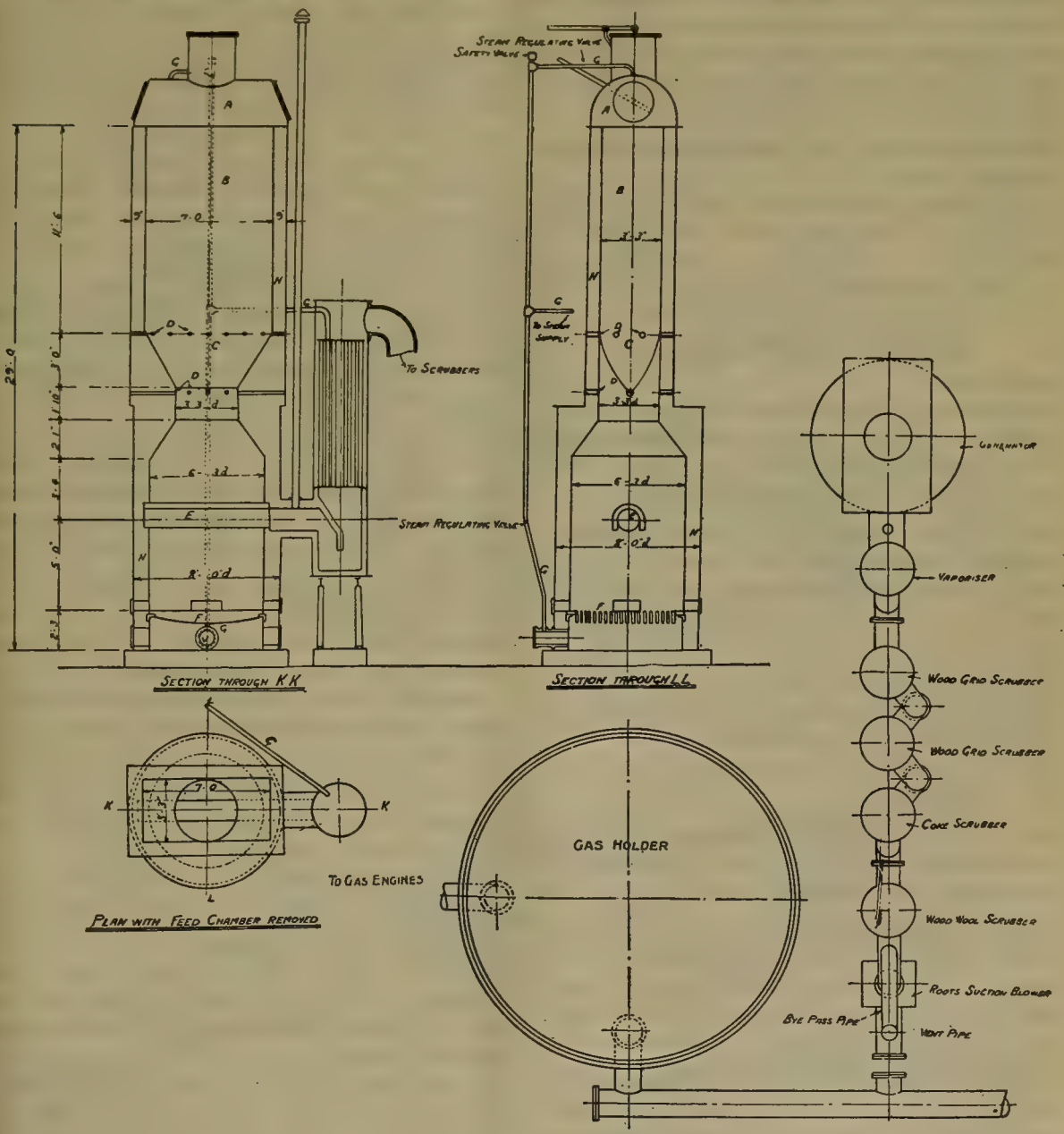
The gas produced has an average value of about 112 British thermal units per cubic foot.

The fuel used contains on an average about 25% fixed carbon.

Two men per shift are employed attending to the producers.

With fire-wood costing 17s. per ton, the cost of fuel per b-hp. is, approximately, 4.8 pence per day, and with labor at 18s. per shift, the cost of labor is 1.7 pence per hp-day, or a total of 6.5 pence per day, or, approximately, £10 per hp. per annum.

The accompanying plan and section gives dimensions and details of the producers in use. Two fires, one at the top tuyeres (D), and the other on the fire-bars (F), are kept continuously burning, the gas from both being drawn off together through a central arch (E), con-



HAMPDEN WOOD-FUEL GAS-PRODUCER

structed of fire-clay or cast-iron. Into the top or feed-chamber (A), the crude fire-wood is fed. As this descends the column (B) of the producer, it encounters the air drawn through the upper tuyeres. This air is regulated to keep a bright fire at this zone. Passing through this zone the oils, hydro-carbons, etc., are decomposed or volatilized, and the wood converted into charcoal. The gas made is drawn down and out through the central gas-vent (E). The charcoal descends past the gas-vent and finally reaches the bottom fire-grate, under which air and steam is admitted as usual, and the carbon is consumed and converted into useful gas, which is drawn up and out through the gas-vent (E).

This producer was designed and built by the staff at the mine, and is known on the market as the Hampden gas-producer.

ERLE HUNTLEY.

Cloncurry, Queensland, June 7.

Revision of the Mining Law

The Editor:

Sir—I have read with much interest the letters of John F. Davis and Emile M. Renaud on the proposed change of the mining law, in the August 20 issue of your valuable paper. Having been a prospector for the last 30 years I feel qualified to pass judgment on at least most of the proposed changes. I have been prospecting and developing goldbearing quartz claims in the upper San Gabriel mining district for the past six years. I and my partner, Ben F. Miller, billed our bacon and beans to the mouth of Iron Fork on the main San Gabriel river, and, armed with a Forest Reserve map, took all the short cuts on foot. The third day after our arrival we discovered a goldbearing vein. Our map showed the country to be surveyed, and some of our locations appeared to be on Section No. 5. As the U. S. law requires the miner to conform as nearly as practicable to the Government survey, we undertook to discover a section corner. Being a practical surveyor and being entirely familiar with all the corners set by a deputy U. S. surveyor on sectionizing and subdividing, I took the map and undertook to find a section corner. After several days of painstaking and systematic hunting I failed to find any evidence of corners or even of lines. A careful inquiry among all the old-timers (some had been on the river for forty years) elicited the fact that they had not seen a corner nearer than 12 to 16 miles. That was in November 1915. After six years residence here and prospecting over every foot of ground, I have failed to find any evidence of Government survey. About two years ago John Hibsch (manager of the H. A. Williams store, at Azusa) representing the heirs of George Trogden, applied for a patent to a placer claim at Iron Fork. He employed a deputy mineral surveyor to survey the claim for patent. He came armed with field-notes from the U. S. Surveyor's office, together with a crew of chainmen and a good compass. After a week or more of surveying he failed to find any Government corners, and was finally compelled to establish a U. S. mineral monument to tie his survey. Mr. Hibsch or the deputy U. S. mineral surveyor will verify this statement. Oregon and other States have many cases parallel to this.

The laws of the State of California require the prospector to stake, blaze, and record his discovery within 30 days after discovery. Without discussing the right of the State to impose such a law on the discoverers of mineral on the public domain, it is apparent that if a prospector was compelled to hire a U. S. mineral surveyor to establish a mineral monument, and tie his description to it, he would not be able to comply with the State law.

To my mind the most serious objections to conforming to cardinal lines is the fact that veins seldom run parallel to the survey lines. Even if the veins run straight, which they seldom do, it would be impossible to conform to the Government lines and cover the mineral.

Section 5B. Subject to limitations. I fail to understand by what course of reasoning consistent with honesty anyone could advocate the location of mining claims without first discovering mineral, since the law already allows you to prospect as long as you feel justified by indications of mineral. By all means let everyone be compelled to discover mineral in place before he can locate. We already have enough locations without discovery, usually surrounding some prospector who is developing his prospect. The legalizing of this class of locations would furnish many additional annoyances to the bona-fide prospector. It would not help the bona-fide prospector in any way, but, on the contrary, would enable the blanketing of all the mineral belts to the disadvantage of the real prospector, besides legalizing the holding of water sources and timber under guise of mineral locations.

Section 5B. Final C. E. in seven years as the primary object. The law should encourage the discovery and development of mines and not the monopoly of mineral sources. I cannot see any reason for compelling the prospector to patent his claim before he knows it is worth patenting. Under the present law, development continues as long as the assessment is required.

Section 6B. Payment into Land Office in lieu of development work. I think the idea is entirely out of joint with all the theory of mining or of mine development. It is too ridiculous to merit discussion.

Section 7. Pertaining to lateral rights. I believe with Mr. Renaud, if not jumping out of the frying-pan into the fire, at least he would have one foot in the pan and the other in the fire.

In conclusion, I will say that I entirely agree with Mr. Renaud, and want to add my wish to his that all miners communicate with their Congressmen and Senators as soon as possible. Congress has always been sane on the mining question, and although we no longer have the venerable patriarch of the Senate from Nevada to champion the cause of our scattered forces, we have some of America's greatest citizens there, who are always ready to oppose wrong and fight for what is right.

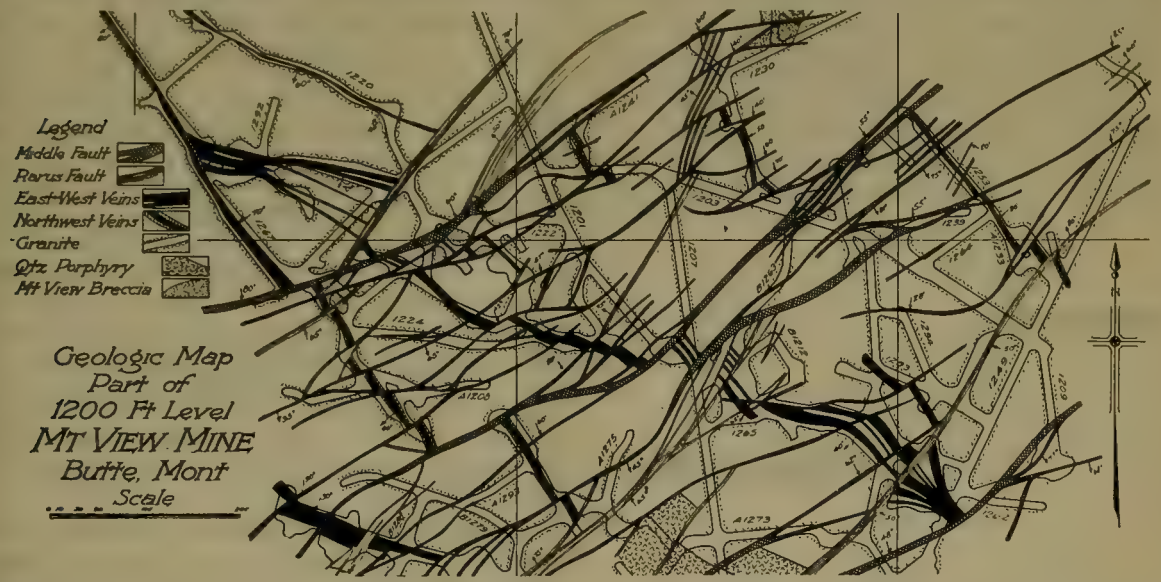
GORDON D. STANLEY.

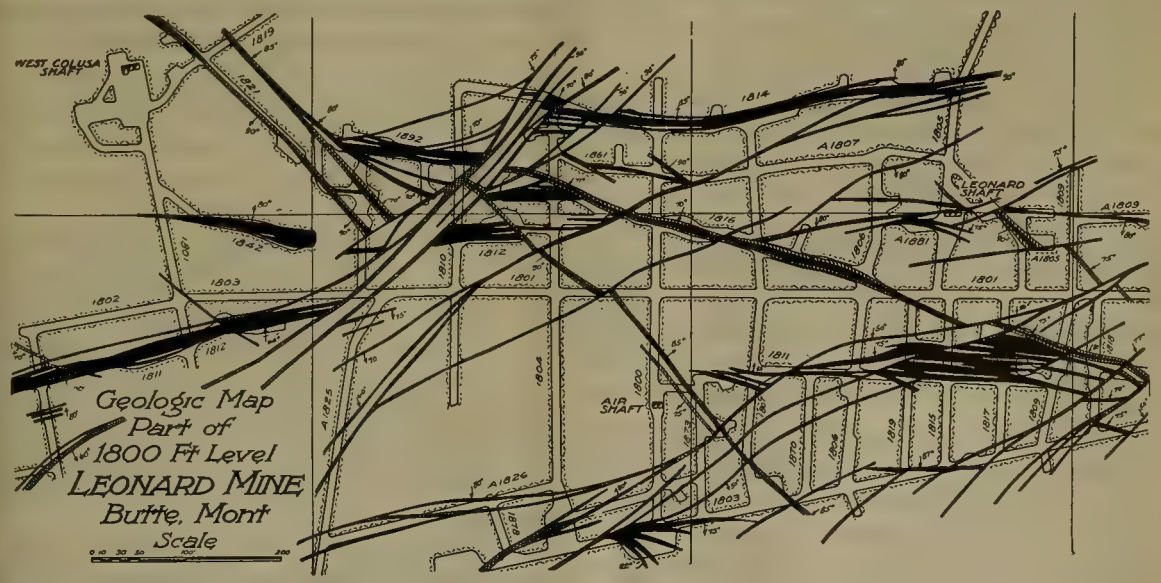
Azusa, California, August 30.

Applied Geology at Butte

By T. A. Rickard

One of the most interesting features of technical practice at the mines of the Anaconda Copper Mining Co., at Butte, Montana, is the systematic recording of geological data on the mine-maps, and the use made of such information for guiding exploratory work underground. It is safe to say that the importance of geologic investigation became appreciated by the management soon after the apex litigation started in 1898. The intricacies of vein-structure and of faulting became matters of dispute in the courts, and specialists in mining geology were retained as 'experts' on both sides. Among the engineers retained by the Anaconda company at that time were David W. Brunton and H. V. Winchell, and it is to them that is given the credit for starting the system of recording and correlating the underground geology on an elaborate series of maps and sections. In later years, Reno H. Sales, who has been at the head of the company's geological department, has carried the work





forward and broadened its scope. In 1905 Mr. Brunton published a terse description of a system of geological maps and sections such as he caused to be elaborated for the Anaconda company.* In 1913 Frank A. Linforth, who is still a member of the company's geological staff, contributed an excellent description of the methods employed.† There seems little excuse for my writing on the subject except as a compliment to those responsible for this good work and for the opportunity of making some friendly comments, such as may serve the purpose of drawing the attention of the managers of mines in other districts to the usefulness of the Anaconda system.

First, it will be well to outline the local geology. This I can do best by referring to the scholarly paper on the 'Ore Deposits of Butte', by Reno H. Sales, presented at the Montana meeting of the Institute in August 1913.‡ The country-rock of the Butte mines is granite, or, more technically, quartz-monzonite. It forms part of a fundamental mass called the Boulder batholith, which, as a magma, rose through the sedimentary rocks at the close of the period associated with the great crustal movement that formed the Rocky Mountains, late in Cretaceous time. The granite is penetrated by dikes and tongues of aplite, which represents a differentiation from the granite when it cooled and cracked. Next came another intrusion of igneous rock in the form of nearly parallel dikes of quartz-porphyry that extended in an east-west direction across what is now the Butte mining area. Much later came an intrusion of rhyolite, in two bodies, one of which forms the Big Butte, the conical hill so prominent in the local topography. From these intrusive masses of rhyolite there extend dikes running north and south, across the copper veins, which apparently were formed before the rhyolite and after the quartz-porphyry, which follows the course of the earliest veins.

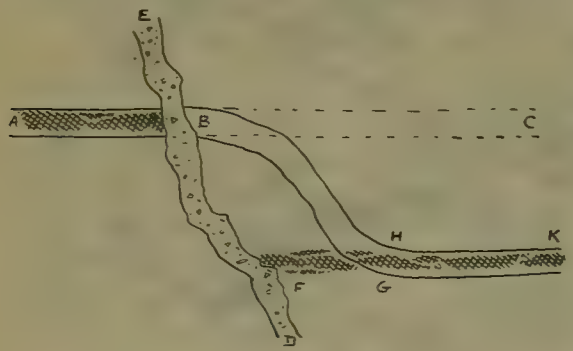


FIG. 1

The granite, aplite, and quartz-porphyry are traversed by systems of fissuring, producing the dislocations called 'faults'. Ore has been deposited in some of the fissures; others are barren and play the unpleasant part, from the miner's point of view, of disturbing the continuity of the orebodies. Six systems of fissuring have been recognized; of these the oldest is the one constituting the Anaconda copper veins, which strike east and west, and dip steeply, usually south. Next, in point of time, comes the Blue system of veins. These also dip steeply, sometimes north, sometimes south; they have a general course northwest-southeast, and therefore cross and displace the east-west fissures of the Anaconda system. Both are crossed and dislocated by a series of breccia faults, that is, fault-fissures filled with angular fragments of rock that have been torn from the walls of the cleft. This breccia resembles concrete. The breccia faults have a general strike of N. 75° E. and dip 65° to the south. They range in width from six inches to 30 ft. Next come the Steward fissures; these displace both the Anaconda and Blue veins, as well as the breccia-faults. The horizontal displacement they cause ranges from 50 to 150 ft. The biggest fault is the Rarus, first recognized in the mine of that name. Its general strike is N. 50° E. and it dips uniformly 45° to the north-west. In places it is 250 ft. wide, of crushed rock. In the Rarus mine it causes a horizontal displacement of 240 ft. It carries no ore except such as it has torn from the veins that it crosses. The sixth system, known as the Middle fault, is the latest in point of time, and therefore displaces all the preceding, as much as 75 ft. It has a strike N. 65° E. and dips south.

Obviously these systems of veining and faulting, with different strikes and dips, produce a complex of fissures and dislocations that renders it difficult for the miner to follow the ore. Indeed, without geologic study and careful mapping, the underground structure would be a maze defying economical exploration. To assist those responsible for the supervision of the mining operations it has been found necessary to make detailed surveys, and to record not only the position of the workings but also the nature of the wall-rocks and fissures observed in the levels and cross-cuts. Thus the navigator underground is given a chart wherewith he may steer his course and so follow or find the ore that is the object of his search in the darkness of the underworld.

At first it was difficult to make the foremen, and even some of the superintendents, realize the usefulness of geologic data in their daily work, particularly of searching for new orebodies and correlating the faulted portions of the known orebodies. One can rarely go 500 ft. without encountering some kind of break or fault. In parts of the workings the displacements may be repeated at intervals of ten feet and in different directions, so that any rule-of-thumb method fails and the foreman is at a loss. The help given to him by the geologist may be summarized as follows:

(1) He need not waste money in cross-cutting where a drift on a vein reaches a fault. The usual and uninstructed method is to continue the drift while thinking what to do. Now the geologist has authority to tell the foreman what to do, that is, which way to cross-cut for

*Trans. A. I. M. E., Vol. XXXVI, pp. 508-540.

†Trans. A. I. M. E., Vol. XLVI, pp. 110-122. Also 'Some Features of the Geological Department of the Anaconda Copper Mining Company', by Paul Billingsley, 'M. & S. P.', June 19, 1920.

‡Trans. A. I. M. E., Vol. XLV, pp. 3-106.

the other part of the vein, which means the probable extension of the ore. The foreman is instructed by the superintendent to follow the advice of the geologist, as represented by a member of that department. For example, in Fig. 1, a foreman might continue the drift *A B* through the fault to *C*. The geologist, after study of the dips and strikes of the intersecting vein and fault, and other structural details, would determine the probable position of the faulted segment of *A B* beyond the fault, and thereupon would instruct the foreman to turn his drift as indicated by the dotted lines from *B* to *H*, the object being to reach the vein beyond the fault with the shortest length of cross-cut consistent with convenience in mining.

(2) It used to be the custom to run short cross-cuts into the walls, to obtain waste for filling. Although this was a cheap method of filling the stopes, the general effect in the mine was not good because it tended to check prospecting and development work on the levels. It is now the duty of the geologist to select the points where cross-cuts and drifts will serve to explore the ground as well as yield waste for the fill.

(3) In the general scheme of mine development, the geologist selects the points for starting prospecting cross-cuts or other work that may serve incidentally as a means of exploration. It is natural for a foreman to select the 'convenient' place for such a cross-cut, having regard to the economical tramming of the waste, rather than the place geologically most attractive.

(4) When a new shaft is to be started, the geologist selects suitable ground. This he can do by reason of his knowledge of the distribution of the various fissures and faults, thereby preventing the sinking of a shaft in bad ground, that is, rock so broken as to endanger the subsequent maintenance of the shaft or possibly the actual sinking of it. Similarly the geologist is able to select a place for the drill-hole through which an electric wire will be extended in order to save the shaft from the danger of fire due to a break in the insulation. Such a drill-hole, of course, must be made in ground that will not shift.

(5) The main purpose of geologic study is to aid in the search for ore. That, of course, represents the direct winning of money, whereas the other aids he gives the miner represents savings, the cumulative value of which runs into a sum comparable with that of a large orebody. The exploration of new ground is based upon careful and detailed study of the maps and sections, and the comparing of ideas between members of the geological staff.

RECOMMENDATIONS FOR DEVELOPMENT WORK
A. C. M. CO. GEOLOGICAL DEPARTMENT

LEVEL 1800
MINE Badger
NO. 1097

Description: Crosscut S 35° W. from A-1876 drift west from a point 425 feet west of 1832 drift west.

Object: To cut Skyrme Vein and other Northwest Veins developed in Diamond southeast of this point.

Blue Print
Approximate Amount of Work 900 feet.
Date of Recommendation 11/12/20 *Recommended by* C. H. Steele
Date Started
Date Finished *Approved by* F. A. Linforth
Results.

FIG. 2. A RECOMMENDATION SHEET

Thirty years ago it was unusual for a mining company to retain a geologist, who was called into consultation only when serious trouble developed, more particularly in the event of a general impoverishment of the mine. The manager or the surveyor was expected to decipher the vagaries of the structural geology, and sometimes he did, but usually a specialist had to be called upon, and only too often he came after much of the evidence necessary for a correct diagnosis had been obscured or obliterated, as the result of mining or caving. It seems a far cry from those hit-or-miss methods of the past to such a system as has been established by the Anaconda company; its success is due in large part to the fact that the decisions for new work underground are not made until the evidence has been discussed by the members of the geological department. A decision is not always the judgment of one man, it may represent the result of a

scientific consultation between several competent geologists.

(6) Last comes the aid given by the geologist in litigation, meaning the lawsuits arising from conflicting interpretations of the mining law, under the provisions of which extra-lateral rights are claimed by neighboring owners to the ore in veins supposed to have their apex in the claims or locations of the opposing parties. The geologist finds it interesting to procure and prepare data for the lawyers. The effort made in a court of law to determine the facts in an apex suit is unscientific because in the last resort the decision rests with a judge or a jury unversed in geology and restricted or impeded by a law inconsistent with the facts of nature.

The educative value, to the community, of such a geological department as that of the Anaconda company is unmistakable. The foremen in the mines were slow to appreciate the usefulness of geology; this was true more particularly of the old-timers, who mined the rich veins, and did not need to be told where to find ore. Moreover, in the early days of the Butte district the miner was not troubled much by faults; these became a serious obstacle only when the workings became deep. How far down the scale of employment the appreciation of geology goes, it is difficult to say. The miners themselves know that their work is guided by the geologists, and so develop an interest in the rock-structure. Directions or orders, of course, are given by the geologists not to the miners but to the foremen; but the miners hear them and that awakens their intelligent curiosity, which is the beginning of scientific study. For a long time the geologist was supposed to be not 'practical', and even to this day there are mining companies that refuse to believe that a geologist can help them. The geologist used to be called a 'theorist', largely because most people do not know what a 'theory' is, but, as a matter of fact, the miner himself, especially the prospector, is full of 'theories', if by them is meant unsubstantial surmises as to the nature and distribution of ore deposits. At Butte the miners see the exploratory work changed by the geologist from day to day in this or that direction, and with such changes they associate the subsequent finding of ore. This must impress them. Some of them at least must realize the difficulty of carrying a mental picture in three dimensions, especially in a mine traversed by many faults, involving big dislocations both vertically and horizontally, and complicated by movement in different directions, where fracture-planes of various dips and strikes intersect each other.

To understand these structural complexities and to interpret them intelligently, it becomes necessary to make accurate maps. These are of various kinds and are drawn to different scales.

(1) Geologic data are recorded on cross-sectional paper in loose-leaf notebooks.

(2) These are transferred to a set of maps on a scale of 50 ft. to the inch. They constitute the permanent official record and on them are recorded all the essential data.

(3) A set of maps on a scale of 100 ft. to the inch is made, to cover a larger area and therewith to co-ordinate the information obtained in the members of a group of mines. Each geologist is given a specified territory and his work is co-ordinated with that of the other geologists.

(4) For small incidental underground problems of a complicated character it is customary to prepare maps on a large scale, say, 20 ft. to the inch.

(5) An entire district is mapped on a 200-ft. scale for the purpose of a comprehensive correlation, giving a bird's-eye view of the geology of the district as a whole, and assisting mental vision at a wide angle.

(6) Glass models are made, to solve local problems. These models are of the kind used in apex suits. Once, however, a man has obtained a good mental picture of a rock structure, he does not need a glass model, which then serves as a means of explaining the geologic conditions to the officers of the company.

(7) In addition to plans, it is necessary to make an elaborate series of cross-sections, usually on a scale of 100 ft. and at intervals of 100 ft. apart, but occasionally in two directions in order to cover both the east-west and the northwest-southeast vein-systems.

(8) To aid those in charge underground it is customary to furnish the assistant general manager and the general superintendent with a complete set of geological maps drawn on a 100-ft. scale. The two assistant superintendents likewise are given sets of maps covering the mines in their charge. The foreman of each mine is given a geological map relating to his mine. The scale of this map will depend upon the size of the area under his supervision.

The general policy of mine development is left to the general superintendent, of course. The amount of such work to be done depends upon the condition of the mine, as to which the superintendent is the proper judge. It is part of the duty of the geological department to provide the superintendent with a list of places inviting exploration. This is done by means of 'recommendation sheets,' one of which is photographed in Fig. 2. If the general superintendent considers that the foreman should do more exploratory work, the latter consults these 'sheets' or goes direct to the geological department for fresh hints. If the foreman is of the opinion that he can do work most conveniently on a particular level, he will turn to his 'recommendation sheets' and ascertain if a place on that level is mentioned; if not, he calls upon the geologists for advice as to the place where he ought to start the work—a place fitting his arrangements underground and one likely to be the most promising for the finding of ore. In general, the foreman is not supposed to start any new work without previous consultation with the geological department, because any work necessary for convenience in mining may be combined with an opportunity for useful exploration.

A definite scheme of coloring is established, as might be supposed. Veins are marked in red, and faults in blue; but where faults are mineralized they are also marked with red. The aplite dikes are marked in green,

so is the Rarus fault; the quartz-porphyry is recorded in yellow. Dotting with small v's show that granite has been recognized. Dips are recorded at irregular intervals wherever a change of dip is significant.

The geology of each stope-floor is mapped and recorded in a set of books accurately oriented. A glass-top table, illumined from below by electric light, is used for making tracings. Sets of maps are kept in steel cases. Tracings of the 200-ft. map are hung on a wooden strip that slips into a groove along the top of the case, so that they hang vertically, can be removed readily, and occupy the least space. As 50 miles of mine-workings are made each year, it is evident that these records are voluminous.

If any further proof of the effectiveness of the geolocigal work be needed, it can be obtained by examining a map and observing with what success the workings follow a multi-faulted vein. It remains to add that the present general superintendent, C. L. Berrien, served with the geological department for five years and obtained a training that has stood him in good stead in the even more responsible duties of his higher appointment. Stoping operations have reached a depth of 3400 ft. in the Original mine, but the deepest level is at 3800 ft. in the West Steward, where 10 ft. of 4% ore was cut recently. At Butte 3% of copper constitutes 'ore' nowadays. The deepest working is 3900 ft. below the surface, this being the depth of both the Original and the West Steward shafts.

Sulphur Industry of Sicily

Until recent years Sicily was an important source of sulphur, but it has now been displaced by America, which has developed a large production owing to the easy extraction from the Louisiana and Texas mines, states a consular report. The production of sulphur in Sicily rose from 120,000 tons in 1860 to 538,534 tons in 1905. In 1919 production decreased to 181,374 tons, but rose to 219,844 tons in 1920. On the other hand, the production of American sulphur increased from 893 long tons in 1883 to 25,000 tons in 1903 and 491,080 tons in 1913, and reached 1,255,249 long tons in 1920. Japan, with an output of about 50,000 tons, is the only other important source of sulphur.

The gradual decline of the Sicilian sulphur industry during recent years is shown clearly by the statistics of production, stocks on hand, and export of sulphur from 1898 to 1920:

Years	Production Metric tons	Stocks on hand Metric tons	Exports Metric tons
1898	465,021	235,022	460,800
1900	516,789	242,438	574,460
1902	501,021	329,836	481,280
1904	499,322	370,606	490,090
1906	475,553	537,588	399,100
1908	404,297	616,419	377,610
1910	397,808	641,249	395,944
1912	356,555	450,917	447,590
1914	334,974	369,001	338,308
1916	233,835	155,372	396,035
1918	194,585	112,050	230,769
1920	219,844	147,886	190,175

From 1860 to 1876 the price of sulphur averaged 140 lire ($27) per metric ton. The return was so remunerative that it encouraged exploration and production, with the result that the price diminished gradually between 1876 and 1895, when it reached the low figure of 55 lire ($10.62) per ton.

To relieve the result of an attempt to corner the market in 1896, a company was organized at London, with a paid-up capital of 20,000,000 lire ($3,860,000), called the Anglo-Sicilian Sulphur Co., for the purpose of controlling the production of sulphur in Sicily, purchasing the product, and re-selling it at a reasonable profit. This arrangement lasted until 1906, when the company was dissolved. Its operation had not met with success, because only about 60% of the mine-owners joined the syndicate, which was therefore unable to control the sales. American competition began to make itself felt; a large reserve stock had accumulated, the disposal of which was a problem.

This prompted the Government to take a hand. A compulsory consortium, or syndicate, was formed on August 1, 1906, in which all producers had to combine for a period of 12 years. The consortium was to fix the price of sulphur periodically, and when necessary to limit the production. It was to be operated by a director-general with an administrative council. Upon its expiration the life of the consortium was extended for another 18 years. The company came to a private agreement with a company in the United States as to the division of foreign fields for the marketing of sulphur. This arrangement was continued in the early years of the consortium, after which it was abruptly terminated, and American sulphur began to enter the European market; Rotterdam, Hamburg, and Antwerp became centres of distribution for the product in northern Europe, and Marseilles in the Mediterranean. In the latter a large plant was erected for the preparation of refined, ground, and other varieties to compete with similar Sicilian products.

Sulphur, which was required during the War for the production of ammunition, was in great demand; but, owing to the lack of ships, the delivery of American sulphur to Europe was interrupted. The Italian government commandeered the sulphur, authorizing exportation only with special permits. Now that freights are again normal, American sulphur exporters are everywhere underbidding the Sicilian product. In fact, the quotation for American sulphur c. i. f. Hamburg, was, at the beginning of June 1921, 1320 marks, whereas the Sicilian product was quoted at about 3000 marks. The latter has been completely displaced in the Scandinavian markets, and is facing keen competition in Belgium, England, the Netherlands, France, Germany, and Africa.

It is said that American sulphur is superior to Sicilian for the chemical industries. However, the latter is preferred locally for the vineyards, where it is used to protect the foliage against parasites, because it is said that the product from the United States does not adhere to the leaf to the same extent as does the Sicilian. Partly for this reason and partly because of their geographic location France, Spain, Portugal, Algeria, and Greece still look to Sicily for sulphur to be used in the vineyards.

Fusion Welding

By A. S. Kinsey

*No modern mechanical process possesses more encouraging possibilities than the welding of metals by fusion. The welded joint is not of modern conception, and the forge weld undoubtedly dates back to the earliest working of metals. However, the other kinds of welds have been in use less than 20 years. All welding is done either by plasticity or by fusion. The forge, the electric resistance, and the thermit-compression welds depend upon plasticity; the electric-arc, the thermit-cast, and the oxy-acetylene welds employ fusion. The respective merits of these two methods of making welds are rapidly becoming understood. Welding by plasticity has accomplished much. We have but to consider the manufacture of ordinary wrought-iron and steel pipe to appreciate the value of the forge weld. The speed and non-oxidizing features of the electric-resistance weld also have proved to the greatest advantage, as in the making of steel chain, for example.

But the plastic weld is limited in its application and is confined almost entirely to mild steel. The fusion weld, however, has a broader range of usefulness among the metals. Especially is this true of the oxy-acetylene weld, which is applicable to mild steel, tool-steel, high-speed steel, the new alloy-steels, cast-iron, wrought-iron, aluminum, copper, brass, bronze, lead, tin, zinc, in fact all of the commercial metals.

The possibilities of a good fusion weld depend on high tensile strength, ductility, density, control of the welders, and a proper method of testing welds.

Tensile Strength. The tensile efficiency of a weld is proportional to its thickness. This efficiency is of first importance, but it must not be obtained at the expense of ductility, that is, the bending and stretching qualities of the metal. In the welding of steel, for example, the ductility is of much importance. Again, to secure the proper tensile efficiency the welded metal must be thoroughly fused to the sides of the V of the base-metal. One of the best ways of securing a high tensile efficiency with mild steel is to use a nickel-steel welding-rod having a tensile strength nearly double that of the original metal. The result is likely to be a weld of higher tensile strength than that of the mild steel. The reinforcing of a weld is common practice.

Ductility. The ductility of a fusion weld, particularly of steel, must be considered, although some would argue that a weld does not need to have bending qualities. One of the best illustrations of the value of ductility in a steel weld is to be found in the manufacture of welded-steel tubing, which can be made cheaper than the seamless drawn tubing. In order to obtain small-size tubing, the practice is to weld the steel in diameters of from 1 to 2 in. and then cold draw these tubes to the smaller sizes desired, some of them being as low as 5/32 in. outside diameter with 1/12-in. hole. It is to be noted that this tubing has an oxy-acetylene fusion weld along its full length, which must be capable of withstanding the strain of repeated cold drawing as the large tube is reduced to the smallest diameter. The weld not only withstands this treatment, but is found to be ductile enough successfully to stand being flattened, crushed, knurled, or bent. The welding of the larger-size tube is done, at the rate of from 3 to 5 ft. per minute, with multiple tips in an automatic machine.

Porosity. One trouble with welds has been the lack of homogeneity of the welded metal, and usually the trouble is due to oxides. This applies to all methods of welding, but probably less trouble is experienced with the oxy-acetylene weld. In most cases the weld must be absolutely non-porous, and the density of its metal should be equal to that of the original metal.

Control of Welders. There must be a better control of welders; we must know exactly what these men are doing. Much attention is being given to this problem at the present time by the American Welding Society. One plan discussed is to require the shop foreman employing welders to have a thorough knowledge of the possibilities of the art, so that he may be capable of inspecting the work of the welders from time to time. The welders themselves should be trained thoroughly to understand the principles of their work, by giving them, say, an evening course in the practical metallurgy of the subject. With these precautions, and assuming them to be of average intelligence and dependability, the danger of poor welds should be greatly diminished.

Testing of Welds. A number of ideas have been suggested for the testing of welds. Some shops require their welders to make sample welds each month which are tested; the results are posted on a blackboard for all the shopmen to read. Another plan is to cut out a section of a weld, where practicable, and examine it for fusion and porosity. If the welder does not know just when his work is to be tested, he is likely to be careful. We know of some cases where welders are being required, after making a good-sized weld, to stamp their initials and the date alongside so that there can be no question as to responsibility if the weld fails.

The fusion weld was first used in the repair shop. During the past five years, however, it has been gradually expanding to the manufacturing plant, where now it is of the greatest value. There was a time when nearly all steel tanks were riveted. Now many of them are being made with all welded joints. The locomotive firebox is now being welded. Intricate castings, formerly impossible to make, are now cast in parts and the parts welded together.

Success has been obtained in the experimental welding of steels containing nickel, chromium, tungsten, cobalt, and vanadium. The depositing of alloyed steel on cheaper base-metals, where intense heat and wear are concerned, has been successfully accomplished by the oxy-acetylene torch.

*Abstracted from an address delivered to the Cleveland Section of the American Welding Society.

LA LLAVE SMELTER AT ZIMAPAN

Smelting Practice in the Zimapan District, Mexico

By Robert B. Brinsmade

Introduction. The first smelting operations in the Zimapan district of Hidalgo, Mexico, began in 1632, to treat the silver-lead ores of the Lomo del Toro outcrop. Judging from the huge piles of slag—estimated at 1,000,000 tons—that mark the seat of the ancient plants, it seems evident that operations must have been continued with regularity since then and at an average rate of 20 to 30 tons daily. It has always been the practice to re-treat the old slag as a help in the smelting of the ore itself.

At present Zimapan contains one copper plant, La Equitativa, and five lead plants, La Llave, San José, La Purisima, San Antonio, and San Nicolas, of which only the first three have been operated during the Revolution. Besides this there are several abandoned lead plants such as the Monserat, La Soledad, El Loreto, El Carmen, and La Cruz.

La Equitativa. This plant is owned by the Hidalgo Copper Mining & Smelting Co., which is controlled by Ludlow Bros. of Pachuca. It possesses two duplicate water-jacketed blast-furnaces which are operated, usually, in alternation, for copper matte. Occasionally one may produce copper matte and the other work-lead, as the change from copper to lead smelting is easily effected by digging out the crucible and decreasing the smelting column from 12 to 10 ft., with a corresponding lowering of the blast-pressure and an increase in the lead of the charge.

The blast-furnace is an excellent example of the type adapted for small operations, to be carried on at a long-distance from a railway and repair-shops. It is of round type with a diameter of 3 ft. 3 in. inside the tuyeres and 4 ft. 6 in. inside the stack. The latter, like the crucible, is built of segmental blocks, cut from local rhyolite, and consists of two layers, of which the inner is 6 in. thick and the outer 12 in. The stack is supported on steel box-girders, which rest on four posts of 6-in. iron pipe, and is capped on the feed-floor by a sheet-iron stack (shown, in the illustration, next to the elevator) with one door for charging. There are 8 water-jackets, of which the six at the sides contain holes for 3-in. tuyeres; the front jacket contains the slag-tap, and the rear jacket is blank. Originally these jackets were of rectangular section and of flange steel; but when worn out they were replaced by jackets made of 12-in. iron pipe flattened to an inside thickness of three inches, closed at the ends with plate-iron, dovetailed to the pipe, and caulked tight with Smooth-On cement. The jacket interstices are luted with clay. The crucible is of cylindrical shape, with a tubular tap for the exit of lead and matte together, when smelting for lead.

The air is supplied at 12-oz. pressure by a No. 4 Wilbraham-Green cycloidal blower, turned by a 10 by 15-in. horizontal slide-valve engine, which is fed by a 25-hp. return-tubular boiler. As blowing one furnace requires only seven or eight horse-powers, the engine can also turn the small dynamo that lights the plant at night. The air reaches the furnace through a 14-in. sheet-iron bustle-pipe, which is joined to each tuyere by a 7-in. nozzle and canvas tube. The tuyere consists of a 3-in.

iron tee whose front and top holes contain 3-in. nipples to connect with the water-jacket and the canvas air-tube, respectively; its rear hole is fitted with a 3 by 1.5-in. bushing and a ½-in. plug for a peep-hole.

The principal ore supply for copper smelting now comes from the Concordia mine in the Monte district, and is bedded in two beds of 130 to 150 tons each, which are fed alternately. The oxides of the upper stopes of the mine are mixed with the sulphides from the sump to produce a bed that contains:

	%
Copper	1 to 2
Lead	4 " 5
Iron oxide	8 " 12
Alumina	10 " 15
Silica	32 " 38
Lime	1 " 3
Silver	600 " 1000 gm.

Besides this, some ore is used from the Purisima mine in the Balcones district; this is a mixture of iron and copper pyrites and contains 4 to 6% copper and 700 grammes or more of silver per ton.

The daily feed to the furnace consists of

	Tons
Ore	10.0
Limestone, 17% of charge	2.9
Custom slag	3.0
Foul slag and speiss	1.1
Total	17.0

For this is required 12% of coke, or two tons, and in case charcoal partly replaces the coke it is reckoned to require twice the weight for the same duty.

Each ingredient of the charge is placed in small iron buckets, and raised from the yard to the feed-floor by an elevator of 300-kg. capacity, operated by a hand-windlass and consisting of two counter-balanced cages. The custom slag is really a low-grade matte, which is picked from the ancient dumps of the city, and assays 2 to 3% copper and 400 grammes of silver, while the 'foul' slag re-treated from the furnace itself assays only 1% in copper.

The slag is tapped every five to ten minutes into cast-iron pots, holding 135 kg., which are wheeled to the dump on a truck and there left to cool on their tripod base. When cold, the matte is broken off the bottom of the slag cone for shipment, and the shell of foul slag returned to the furnace. The waste slag runs 35% silica, 30% iron oxide and alumina, 16% lime, and 0.2% copper. While the matte runs 8 to 10% copper and 3 to 5 kg. silver per ton. Thus the concentration is 5:1 on a charge going 1.6 to 2.0% copper and 600 to 1000 grammes silver. Owing to the presence of arsenic and antimony in the charge, there is always a little speiss produced; this is broken off from the matte and returned to the furnace for de-silverization along with the foul slag.

The laborers work in 12-hr. shifts, and their wages vary from ₱1 per day for the unskilled to ₱1.50 for the tapper. The blast-furnace occupies 10 men per shift, distributed thus: one tapper, one helper, two slag-wheelers, one engineer and fireman, two elevators, two feeders, and one fuel-wheeler.

La Llave. This plant is owned by the Cia. Minera de Zimapan, and up to 1913 ran mostly on custom ores; but during the Revolution the company acquired many mines, from which 80% of the present ore supply is drawn. The process used involves blast-furnace smelting, a stall-roasting of the matte, and a refining of the work-lead for the production of litharge and silver bars for the local market.

Blast-Furnaces. There are two rectangular and one round water-jacketed furnaces. The round furnace has eight jackets, made of flattened 12-in. pipe as already described, with a slag spout in front and a siphon tap behind, and it was formerly run continuously in alternation with a duplicate furnace. The present practice, however, is to run only one of the big rectangular furnaces, intermittently—the ore supply is insufficient to do otherwise—leaving the other rectangular and the round furnace in reserve. Each rectangular furnace is 36 by 72 in. at the tuyeres, with one steel jacket at each side (containing four 3.5-in. tuyeres) and one at each end. The rectangular shaft above the jackets is 4 by 6 ft. in its interior section, and is lined with fire-brick that rests on steel box-girders supported by a cast-iron post at each corner. The smelting-column is held at 12 ft. above the tuyeres except in case of an excess of fines. The blast is suppiled at 12-oz. pressure by one Wilbraham-Green cycloidal blower, with a No. 1 Root blower in reserve, each belted to a Vim horizontal engine of 20 hp. Steam is supplied by a return tubular-boiler, which consumes 2 tons of local wood daily when blowing one of these 50-ton furnaces.

Unlike the copper-furnaces, these blast-furnaces are set on a side-hill bench, and consequently the storage-bins are on a level with the feed-floor; the ore needs no elevating before charging. The ores treated may be classified in two groups:

	Silver	Lead
Lime	22%	6 to 10%
Iron oxide	6 to 8%	18 " 20%
Silica	8 " 14%	22 " 24%
Silver	800 " 2000 gm.	600 " 1000 gm.
Lead	.....	12 " 20%

And a typical charge of 500 kg., of which four may be fed per hour, is:

	Kg.
Ore	300
Limestone	40
Roasted matte	25
Foul and custom slag	75
Cupel slag	10
Charcoal and coke (11%)	50
Total	500

This yields a slag assaying: FeO, 28%; CaO, 14 to 16%; Al_2O_3, 8 to 9%; Pb, 0.5 to 0.1%; and Ag, 30 to 35 grammes.

No speiss is accumulated from this furnace, the arsenic in the ore being volatilized in the furnace or during matte-roasting. The slag is tapped into small slag-pots,

and handled as already described. The matte is broken off the bottom of the cold-slag cones, and sent to the stalls; the work-lead is ladled out of the siphon tap into molds for cupelling. To operate the furnace requires, per 12-hr. turn: one tapper, one helper, two slag-men, one engineer, one boiler-man, and five feeders.

The Roasting-Stalls. These are built of brick or stone and comprise 17 stalls; of which three are 6 ft. wide by 9 ft. high by 7 ft. long and hold 16 tons; the remainder are 5.5 ft. wide by 6 ft. high by 7 ft. long, and hold 10 tons. In shape they are rectangular, with an arched roof, 12 in. thick, and are built in a row side by side, so as to avoid the use of buck-stays; they debouch into a brick flue in the rear, of 4 ft. width by 7 ft. height. This last flue, in turn, is cut at right angles in the centre by another flue, 160 ft. long, which is terminated by a brick smoke-stack 3.3 ft. square inside, by 40 ft. high, and is shown at the extreme right in the illustration.

To light a 10-ton kiln requires 400 kg. of wood; roasting is allowed to proceed for 10 or 11 days, so that the 18 to 20% of sulphur in the original matte is reduced to 8%. The copper in the primary matte is only 1.5 to 1.8%; but, by successive roasting and re-smelting, this is finally raised to 11%; it is then shipped for refining to Aguascalientes.

Refinery. This comprises two round cupelling-furnaces built of stone, hooped with steel, and lined with fire-brick; the hearth, however, is formed of a mixture of ground quartz and slag. The charge of work-lead consists of 10 tons; it is fed gradually, and finished, for silver bars of 35-kg. each, once in 80 hr. The cupelling is attended to by three men on 12-hr. shifts; the litharge yielded is sold locally, and is mostly used for glazing the native earthenware. The dust-flue that takes the blast-furnace smoke is built of rubble stone-masonry with an arched roof, and is 6 ft. high by 4 ft. wide inside. It follows up a gentle slope to a stone chimney 6.5 ft. square inside, by 60 ft. high. The trapped dust is mixed with lime, made into bricks by hand, and dried in the sun for smelting.

The ore is brought in sacks to the plant, and is dumped into flat ore-bins, which are separated by stone walls and paved with cobble-stones. Every fifth sack or so is taken for a sample and this is dumped onto the pile nearby. Each sample-pile is reduced, by quartering and coning, to a sample for assay. The coke is also kept in roofless flat bins, but the charcoal is stored in bins with high stone walls and corrugated-iron roofs. The offices and warehouses are built of stone, with iron roofs; the furnace sheds have similar roofs, but merely wood frames.

San José Silver-Lead Smelter. The blast-furnace here is round, and of 33-in. inside diameter at the tuyeres, of which there are five of 3-in. diameter, one in each of the steel water-jackets. The siphon-tap has recently been taken out of the crucible, because it continually clogged from the chilling of speiss; only one of the arsenides of iron is easily fusible, the remainder being pasty at the ordinary furnace temperature. The lead and matte settle together in the crucible and, every 3 or 4 hr., are tapped out into a flat hole in the floor that is lined with clay. From this hole the work-lead can be ladled into iron molds, and is clean enough for direct cupelling; the scum of the hole is a mixture of matte and speiss, and is crushed for roasting. This furnace treats 15 tons of ore per day, which means a total charge of 25 tons. The work-lead output is at least 7% of the charge of ore and flux, and averages 8 to 10 kg. of silver, or about 1%. The furnace is blown by a 60-hp. Corliss engine, which was formerly used at the dismantled Monserat plant and is consequently much too large. However, by using only 50 lb. steam pressure and a minimum cut-off, the engine output is reduced to the 15 hp. or so needed for the No. 3 Root blower that supplies the blast-furnace with air.

A noteworthy feature of this plant is the sintering roaster devised by Aloys Preusser, the metallurgist and owner. Raw sulphide, matte, or speiss is first broken in a jaw-crusher, and then ground in a pair of 24 by 12-in. rolls to ⅛-in. diam. The sintering furnace consists of a steel stack of 26-in. diam. by 120 ft. high, around whose brick base are placed three fire-places, each surmounted by an iron grid, 7 ft. long by 3 ft. wide, and sloping outwardly at 4 to 1. These grids are made of cast-iron grate-bars, closely spaced; on them is spread a charge of crushed ore, 4 in. thick, and of such a composition, respecting lead and iron, as to sinter easily. The ore is lighted by igniting a cover made of dry maguey leaves, or other refuse fuel, and continues to burn for 1 to 1½ hours, until the original content of sulphur of 15 to 20% has been reduced to 3 or 4%. In the day shift, of 12 hr., each of the three grates can put through eight charges of 400 kg., or a total of three tons. This method of sintering is a great improvement over the heap-roasting formerly in vogue for the same ore at the Balcones mine. The heaps were built to hold 200 tons of ore, and to reduce the sulphur content from 15 to 20 down to 6 to 8% might require two or three months. It was found advantageous to build these heaps on a porous floor, like a mine dump, so as to promote ventilation.

Purisima Silver-Lead Smelter. This plant offers the best example of smelting in blast-furnace unprovided with water-jackets. There are twin round-furnaces of an inside diameter of 84 cm. at the tuyeres. The crucible and stack are built of local porphyry, cut of segmental shape in two layers, each about 9 in. thick, so the outside diameter is nearly 6 ft. The stone furnace is enclosed from tap to feed-floor by a sheet-iron shell; when the inner lining of stone is slagged out, which usually requires a month, the active furnace is blown-out for repairs, and the one held in reserve is blown-in. This furnace will handle about 10 tons of ore and flux daily, with a consumption of 12% of charcoal, and requires an 8-hp. steam-engine, which consumes only ½ ton of wood per day. There is no siphon tap, but lead and matte are tapped every three hours from the crucible into a hole in the floor, and handled as described for the San José furnace. Air is supplied through three 3-in. tuyeres from a Root cycloidal blower. The ore of the

Ortiga camp charged here contains from 12 to 15% lead, and 600 to 800 grammes silver; only 25% of foul slag and some limestone and iron ore are needed to make a fusible slag. In 1919 the lead matte could be shipped to Aguascalientes when it assayed 8% of lead and 2 kg. of silver, but now it would hardly pay. The work-lead here contains 5 kg. of silver per ton, and is cupelled for marketable litharge and silver. The small quantity of speiss produced is used as a furnace 'medicine' to scour out accretions on the lining. For a small furnace like this the absence of water-jackets undoubtedly hinders freezing and saves fuel, but has the disadvantage of more frequent blow-outs in order to repair the lining.

San Antonio Silver-Lead Smelter. This plant was re-built in the 'nineties, but was never blown-in because of an insufficient ore supply in the Lomo del Toro mine. The new blast-furnace was supplied by the Colorado Iron Works Co., and is 30 by 60 in. inside the tuyeres, of which there are three of 4-in. diameter on each side and one at each end, or eight in all. The water-jackets are of cast-iron, three on each side and two on each end, or ten in all. There is a slag tap at each end, and a siphon lead tap at each side of the crucible. The furnace is built against a hillside, so that the ore-bins are situated on the feed-floor, which is 15 ft. above the tuyeres. Power is furnished by a 30-hp. Erie return-tubular boiler, which supplies an Erie horizontal centre-crank engine belted to a Connersville cycloidal blower. The cupelling furnace is built of stone, with a brick-and-stone chimney, and is distinguished by having an iron-bound removable brick roof, which places it within the German type of cupel.

Transportation at Zimapan. One of the greatest handicaps to smelting operations has always been the distance from railway transportation; the heavy grades on the roads are such that the use of motor-trucks or caterpillar tractors is impracticable. Sayula, on the Nacional railway, is 45 miles; Ixmiquilpan, on the Honey railway from Pachuca, is 28 miles away. In fact, pack-animals are found cheaper and more convenient, for bringing smelter supplies, than carts. Coke arrives at Sayula direct from the Coahuila coalfields, and is brought by burros to Zimapan, who carry back litharge and matte, as return freight, from the La Llave smelter. The trip to Ixmiquilpan is hillier but shorter, so it is gradually displacing the Sayula route. The survey for the Honey railway from Ixmiquilpan to Zimapan was completed long ago; but, owing to the Revolution, its construction has been indefinitely suspended. Until Zimapan has direct railway connection, little can be done toward utilizing the large bodies of lead-zinc sulphides that have been developed in the Balcones mining camp

Owing to scarcity of fodder at Zimapan, due to lack of rainfall and shortage of water for irrigation, the transport of ore from the mines, and of charcoal from the wooded mountains to the east, is costly. The freight on ore from Balcones camp is $10 per ton, and is considerably more from either Monte or Ortiga; it is nearly half this sum from even the nearby camps of Arcabuz and Poder de Dios. Charcoal is getting gradually scarcer, and its price, together with that of cordwood, is steadily rising, as they have to be garnered at greater distances. At present, charcoal varies in price, seasonally, from $27.50 to $33 per metric ton; wood is worth $14 per cord.

Outside Smelters. The numerous small plants in the Zimapan district, outside the city, possess little beyond historical interest, as only one is at present in operation —the Barrera lead-silver works at Cardonal. This smelts in one of two small stone furnaces, which treat about 1.5 tons of ore daily, containing 20% lead, together with a nearly equal quantity of flux and ancient slag, using charcoal as fuel. The furnace is blown by a cycloidal blower, which also supplies the air for cupelling. The blower is turned by a 5-hp. engine, the steam being supplied by a wood-burning boiler.

After the Armistice, zinc production was not begun in Belgium until May 1919; owing to the difficulty in securing coal and ores, the monthly production at the close of that year was less than 5000 tons, states a consular report. In 1920, conditions improved, and in May the production of raw zinc amounted to 7370 tons. The Belgian production in 1920 was 82,960 tons, in comparison with 19,860 tons in 1919 and 204,220 tons in 1913. At the close of 1920, Belgian producers began to curtail production, and the total yield of Belgian plants decreased to 6530 tons in February, 4640 tons in March, and 4320 tons in April 1921. Belgian manufacturers claim that, with the present prices of coal and labor, profitable production is impossible; zinc prices, which were 2300 francs per ton in January 1920 and 2850 f. in February, have now dropped to 1450 f. The Mines et Fonderies de Zinc de la Vieille Montagne produced, in 1920, 19,080 tons of raw zinc, and 70,000 tons of finished zinc products, in comparison with 130,000 tons of the latter annually before the War. The production of sulphuric acid for the past year by this plant was only 10,000 tons, as against the pre-war production of 100,000 tons per year. In general, however, the production of sulphuric acid in Belgium was unfavorable; approximately 400,000 tons of acid was produced in 1920. Besides the Vieille Montagne, there are in Belgium three other important zinc concerns—the Société Métallurgique de Corphalie, with a plant near Huy, which during the fiscal year 1919-'20 produced 3772 tons of raw zinc; the Compagnie des Métaux Overpelt Lommel, with plants in the northern part of the Province of Limburg, producing zinc, sulphuric acid, arsenic, and superphosphates; and the Société de la Nouvelle Montagne, producing at present about 10,000 tons of zinc products annually, including 5930 tons of raw zinc and 4438 tons of rolled zinc in 1920. This plant also produced 19,223 tons of sulphuric acid during the past year. Only two Belgian plants manufacture lithopone. They are the Société Anonyme des Produits Chimiques de Wilsele, near Louvain, and the Société Anonyme Stella, at Haren, north of Brussels.

The Magnetometer as an Aid in the Development of Mines

By Arthur Gibson

Introduction. The original Swedish mining compass, commonly called the dipping needle, invented more than 150 years ago, has been superseded by a sensitive type of instrument, known as the magnetometer. Magnetometric instruments for the determination of the earth's magnetic field were invented and developed in Sweden, and have been in use more than 40 years. Their application, so far, has been confined almost exclusively to iron-ore deposits, but I have obtained good results by the use of these instruments in both placer and hard-rock mining.

The design of the instruments has been improved greatly during the past 25 years, and it now proves a valuable aid to mining. Quoting Eugene Haanel's book 'On the Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements': "In the hands of experts, furnished with such instruments, the Swedish methods yield data from which magnetic orebodies may be located, and in many cases their strike, direction of dip, and depth below the surface determined." Outside Sweden, such instruments have been used extensively in several of the European countries, in Canada, and at the iron mines in the Eastern and Middle States of the United States. The Swedish government had an exhibit of magnetometers in the Swedish building at the P. P. I. exposition; the University of California bought one of them for their mining department.

Description. Magnetometers are constructed to record either horizontal- or vertical-, or both horizontal- and vertical-magnetic intensities. The old method of reading the angle of variation, deviation, or deflection in the horizontal plane, and the angle of inclination or dip in the vertical plane of the magnetic needle, direct by degrees and fractions thereof, has been discarded, and a compensating or deflecting magnet has been introduced, whereby much closer and more accurate readings are obtained. The compensating magnet acts on the principle of like poles repelling and unlike poles attracting each other, thereby forcing the magnetic needle into certain positions when moved toward or away; the reading thus recorded is a measurement of the distance between the magnetic needle and the compensating magnet. The greater the magnetic intensity, or local attraction, the shorter the distance between the magnetic needle and the compensating magnet, and *vice versa*. One magnetometer, the Thomson-Thalén type, has the compensating magnet attached to a graduated stem that is operated by a micrometer screw, which is divided into 100 parts, each division representing a movement of the compensating magnet of three ten-thousandths (0.0003) part of an inch; this illustrates how much closer the readings are as obtained by magnetometers than by the old method of reading the angle direct.

Magnetism of Ore Deposits. Magnetic minerals can be classified into attractile magnetic minerals, and retractile magnetic minerals. Attractile magnetic minerals, such as magnetite and pyrrhotite, like tempered steel, retain their magnetism when once magnetized. Retractile magnetic minerals, such as hornblende and pyrite, like soft iron, become magnetic when attracted by a strong magnet, and lose their magnetism when removed from the magnet. Retractile magnetic minerals, in order to act as magnets, require a greater inductive force than that produced by the earth's magnetic field, and do not alone have any influence on a magnetic needle. When mixed with attractile magnetic minerals they become magnetic and exert a much greater influence on the magnetic needle. A deposit of magnetite and pyrite has a much stronger influence on a magnetic needle than a deposit of pure magnetite, other conditions being identical.

The magnetism of ore deposits may be due to the presence of attractile magnetic minerals, to the inductive effect of the earth's magnetic field, or to the inductive effect of electrolysis in the ore deposit. A mineral deposit containing two or more minerals, of which one is always more positive and one more negative than the other, electrically speaking, is frequently the centre of electro-chemical action that results from the penetration of surface water through fissures, crevices, or porous rocks, the water becoming alkaline or acid. This process is generally the cause of secondary enrichment, which rarely extends further than a depth of from 200 to 300 ft. below the surface.

These conditions are not alone confined to mineral deposits in hard rock or solid formation; they apply as well to some placer deposits. Gold has no attraction for, or effect on, the magnetic needle. Magnetometric indications of a mineral deposit or a concentration in a placer is due either to the presence of black iron sand, which generally follows the gold, or to two or more minerals. I have obtained good results by magnetometric surveys in placer deposits, and where there was no evidence of the presence of any magnetic (attractile) minerals.

Magnetometric Observations and Determinations. Observations must be conducted by experts in order to obtain reliable results; this is particularly true in regard to calculations of the depth of orebodies. Magnetometric surveying is classified into horizontal and vertical measurements. The horizontal measurements are of minor im-

portance, but the vertical measurements furnish data from which valuable charts are platted, showing the extent and position of the ore.

A compass-needle that is influenced only by the earth's magnetic field is placed in what is termed the normal or neutral magnetic field, and a compass-needle that may be influenced by an ore deposit, or other local magnetic attraction, is placed in what is termed the disturbed magnetic field or, simply, the magnetic field. A compass-needle free to swing in the horizontal plane will place itself with its axis north and south, in the magnetic meridian. The magnetic meridian, with few exceptions, does not coincide with the true or astronomic meridian, the angle of deviation being termed the magnetic variation, or deflection. This magnetic variation is due to the influence exerted by the earth's magnetic field, and to other local magnetic attractions; it is either increasing or decreasing at an average rate of one to four minutes annually, depending on the locality. A compass-needle free to swing in the vertical plane, in the normal magnetic field, will place itself with its axis forming an angle with the horizontal plane; this angle is termed the angle of inclination, or dip, and is parallel to the magnetic lines of force for any certain locality. In the northern hemisphere, the north end of the needle dips when in the normal magnetic field; at the magnetic north pole, the needle will place itself perpendicular; at the magnetic equator it is horizontal.

The strength of the earth's magnetic force varies according to position upon the earth's surface. The total magnetic intensity of the earth at the north magnetic pole is equal to 0.64 centimetre-gramme-second; at the magnetic equator the average value is 0.32 c.g.s. The angle of inclination or dip in a disturbed field is generally greater than in the normal field for the same locality, but it may be less, or even reversed; in some instances the south end of the magnetic needle may dip on the northern hemisphere, which then is termed south polarity. North polarity is always considered positive, and is indicated on charts by a blue color; south polarity is always considered negative and is indicated on charts by a red color.

A magnetometric survey is conducted, first, by a preliminary investigation with a magnetometer, or dipping needle, to ascertain the approximate position and strike of an ore deposit; and, second, by dividing the surface into squares with sides of from 30 to 50 ft. that follow a base-line along or parallel to the general direction of the strike of the orebody. Magnetometric observations are taken at each intersection, with intermediate observations if necessary; from these the corresponding total vertical magnetic intensities of the orebody are calculated, and subsequently platted on charts. Calculations of the total horizontal- and vertical-magnetic intensities of the earth's normal magnetic field, and of an orebody, are too exhaustive to be discussed. For a full and detailed account see Eugene Haanel's book (No. 4), listed at the end of this paper.

Charts of Vertical Magnetic Intensities. The total vertical-magnetic intensities are platted on cross-section paper, and like or identical values are connected with contour lines, isoclinal or isodynamic lines, which show at a glance the location of the ore deposit.

The following rules must be observed closely in order to obtain accurate and reliable magnetic intensity charts: It is important to find the position for the maximum value of the vertical-magnetic intensity; for this purpose it may be necessary to take observations at 10- to 15-ft. intervals at and near the point of maximum magnetic intensity. Contour lines, showing elevations, should be platted on these charts wherever the surface is hilly or mountainous, otherwise serious errors may occur as to the true position and extent of the orebody. Objects such as houses, roads, rivers, lakes, telephone- and telegraph-lines, high-tension electric-lines, and railroads must be marked correctly on the charts for future reference. It is important to mark correctly the position of any and all dumps of magnetic rock on the surface, which generally show negative attraction along the sides, and positive attraction on top and underneath. The astronomic as well as the magnetic meridian, the latter in the earth's normal magnetic field, should be marked on the charts.

These vertical magnetic-intensity charts will indicate that the strike of the orebody is along the direction of the longest axis of the curve of maximum magnetic intensities; the dip of an orebody is indicated by the slow decrease in the vertical magnetic intensities in this direction; the most suitable location for a prospecting shaft is within the contour line representing the maximum vertical-magnetic intensities. The charts will show the extent of the mineral deposit or orebody.

The distance of the upper pole or apex of the orebody below the surface or plane of observation can be determined approximately. Several methods of calculation can be employed for this purpose. The depth of an orebody can in certain cases be determined approximately. Several methods of calculation are mentioned in Eugene Haanel's book, previously mentioned. The general rule is that the orebody has a considerable depth where the north-pole attraction shows a great width.

Profile Curves. Profile curves of vertical-magnetic intensities along lines crossing an ore deposit at right angles to its strike are constructed by using distances between points of observations as abscissas, and values of vertical-magnetic intensities as ordinates. These curves show distinctly that where the vertical-magnetic intensity is at a maximum, the distance from the surface or plane of observation to the orebody is at a minimum. Where several orebodies occur in close proximity and more or less parallel to each other, the profile curves become complex, and it will be necessary to analyze them into their component curves.

Corrections to be Made. Corrections must be made in order to obtain true and accurate values of the observations. Errors in this connection may be due to annual changes of the magnetic variation, diurnal changes of magnetic variation, temperature variations, which are the most important, and sudden variations, due to cosmic magnetic disturbances.

The annual changes of the magnetic variation are constant from year to year for both rate and direction, thus the corrections in this case are readily made. The diurnal changes of the magnetic variation are generally small, and are corrected ordinarily in conjunction with temperature corrections. Temperature variation in some climates differs considerably between morning, noon, and night; this affects the instrument as well as the magnetic needles. The errors caused by temperature variations in the direct-instrument readings may at times reach the most unexpected magnitude; and, for this reason, observers are cautioned not to overlook this matter. Sudden variations, due to cosmic magnetic disturbances, are, as a general rule, impossible to calculate or estimate; it is inadvisable to take observations during electric storms.

PRECAUTIONS TO BE OBSERVED. The observer should assure himself that he is carrying no magnetic bodies, such

THALEN-TIBERG MAGNETOMETER, PROVIDED WITH TANGENT ARM, FOR READING VERTICAL INTENSITIES

as pocket knives, keys, stick-pins, iron buttons, or hat wires on his person.

Magnetic bodies that occur in the field, and cannot be removed, such as magnetic-ore dumps or corrugated-iron buildings, must have their position accurately marked on the charts, so that the disturbing effect may be estimated. Bright sunshine, and the friction caused by wiping the glass cap of the compass-box, will electrify the glass, rendering the needle indications untrustworthy. By breathing upon the glass the electricity is discharged. The strength of a magnet decreases with increase in temperature; it recovers its original strength upon a return to normal temperature. Magnetic observations should not be made during rapid variations in temperature. The strength of a magnet decreases permanently as a result of concussion. The glass cover of the compass-box should be opened as seldom as possible, in order to avoid an accumulation of dust in the bearings, which reduces the sensitiveness of the magnetic needle. An accumulation of moisture on the needle during damp weather may impair its balance, and may cause defective readings when used as an inclinator or dipping-needle. Moisture is best removed from both glass cover and needle by placing the instrument in a warm room until dry, with glass cover open if necessary. No observations should be taken during electric- or thunder-storms; magnetic readings are then more or less unreliable. Cloudy days are best for the taking of magnetic readings in the field. The instrument must be shaded from bright sunshine. Magnetometric instruments appear most sensitive at full moon.

THALEN-TIBERG MAGNETOMETER, PROVIDED WITH TANGENT AND SINUS ARMS, FOR READING HORIZONTAL INTENSITIES

THOMSON-THALEN MAGNETOMETER, FOR READING VERTICAL INTENSITIES

The storing or carrying of magnetometric instruments in close proximity to direct-current generators or motors should be avoided. For instance, while riding on an electric street-car the magnetic needles may become de-magnetized, or the poles may become reversed, thus rendering the magnetometer worthless for field use until re-magnetized and adjusted. The greater the sensitiveness of

the magnetometer, the more reliable the results. The observer must, therefore, be prepared to re-magnetize and adjust his magnetometers in the field in order to ensure accuracy.

False Conclusions From Magnetic Surveys. Every attraction upon the magnetic needle extending over a large area does not indicate necessarily the presence of a mineral deposit of commercial value. Volcanic rocks and lava, more or less impregnated with magnetite, occur at numerous places, but they never contain magnetite in sufficient quantity to be classed as iron mines. These rocks attract the magnetic needle, generally over a large area, but do not show any definite or distinct area of maximum magnetic intensities. A series of observations taken at short intervals along a line crossing a deposit of this nature, at right angles to its general course or strike, shows a continuous variation of the vertical-magnetic intensity, in the same way as if a great number of separate and parallel orebodies did occur. A true orebody that attracts the magnetic needle, always shows one or more areas of maximum magnetic intensity.

Placer deposits containing black iron sand show light magnetic intensities along the course of the stream, with segregated sections of greater magnetic intensities that are due to a more intensified mineral concentration at 'drop-offs' or natural riffles in bedrock, and along the inside curves in bends or turns of the stream.

Conclusions. Magnetometric observations of vertical-magnetic intensities of ore deposits do not indicate any specific mineral or its value—these questions must be solved by actual prospecting and development work—but they indicate the sections that contain the greatest mineral concentration. Thus the battle is virtually half won when an engineer knows where to sink a shaft or where to commence development work, in order to reach an ore deposit with the least loss of time and with minimum expense.

It is true that some ore deposits have no effect on the magnetic needle, and cannot be traced or found by the aid of the magnetometer; but in most instances there are indications of weak vertical-magnetic intensities, if the magnetometer is properly sensitized and in perfect adjustment.

Magnetometric investigations are particularly valuable for ascertaining the position and extent of iron-ore deposits; also for picking-up the extensions of mineral deposits, in hard rock or solid formation, that have been displaced or faulted, or are covered and obliterated; in the exploration of placer deposits covered by lava, gravel, or other material, or in unknown narrow sinuous channels in wide valleys, where the cost of prospecting would otherwise be too great.

Magnetometric observations that indicate a mineral concentration in placer formation is no index of the presence of gold, but it does indicate that placer gold, if there, will be found where the mineral concentration is indicated; and this is where the miner or prospector should look for it.

Bibliography

(1) 'Investigations of Iron Ore Deposits by Means of Magnetic Measurements', by Robert Thalèn. Published in 'Jernkontorets Annaler', 1879, Stockholm, Sweden. Printed in Swedish.

(2) 'Account of Magnetic Measurements of Iron Ore Deposits by Means of the Magnetic Inclination Balance (Dipping Needle)', by Enoch Tiberg. Published in 'Jernkontorets Annaler', 1884, Stockholm, Sweden. Printed in Swedish.

(3) 'Account of Magnetic Deposits and Their Examination by Means of the Magnetometer', by Th. Dahlblom. Published by Carl Nordins Book-Store, 1898, Falun, Sweden. Printed in Swedish.

(4) 'On the Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements', by Eugene Haanel. Published by the Department of the Interior, at Ottawa, Canada, 1904. Printed in English.

(5) 'A Brief Account of a Magnetic Survey of the Iron Ore Field of Kirunavaara (Sweden) made in the years 1900-1910', by V. Carlheim-Gyllenskold. Published by Kungl. Boktryckeriet, Stockholm, Sweden, 1910. Printed in English.

In a paper read before the British Association, at Cardiff, H. M. Wells and J. E. Southcombe gave the reason why the fatty or fixed oils possess superior friction-reducing properties to that of mineral oils. They have shown that this is due essentially to the presence in fatty oils of minute quantities of free fatty acids, which are absent in the majority of mineral oils. In consequence of this discovery they have added small quantities (about 1%) of fatty or organic acids, which are easily accessible and relatively cheap, to mineral hydrocarbon oils. The products so obtained possess remarkably low frictional coefficients. An an example, the addition of 2% of common fatty acid to a mineral hydrocarbon oil reduces the coefficient of friction shown by this oil on a friction-testing machine from 0.0084 to 0.0052—a diminution of 26%. By choosing the type of fatty acid to be added to mineral oil, the behavior of oils in the presence of water and other contaminating substances can be modified at will. It is also shown that the risk of metallic corrosion is even less with these oils than with the usual compounded oils, because the latter frequently develops in working notable quantities of free acid.

Gold may be electrolytically deposited, rapidly and quantitatively, from solutions of the chloride containing acetate, this method admitting of the separation of gold from copper, palladium, and platinum, according to W. H. Treadwell, in 'Helv. Chim. Acta'. The readiness with which palladium is attacked in comparison with platinum, when subjected to anodic polarisation in hydrochloric acid solution, serves as a means for the approximate estimation of the palladium content of a precipitate composed of a large proportion of palladium and little platinum.

Book Reviews

Mine Accounting and Cost Principles. By T. O. McGrath. 260 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price $4.

The author, who is the auditor of the Shattuck-Arizona Copper Co., shows that the present tax laws of most of the States and of the Federal government require that accurate records be kept and that complete reports be made to the Government of the results of each year's business. The employees of large industrial units are demanding that they be informed of the results of their labor, and be given a share either of the profits of the business or in the savings resulting from their increased efficiency or effort. The general public is insisting that, because it is the consumer of all products, the costs and profits of industry shall be accurately determined and made public. The mining industry is operating on a narrow margin of profit; to protect against loss, the costs must be known from month to month. These preliminary remarks indicate the demand that is now being met by the publication of the book under review, which contains a complete presentation of the principles of accounting and costing of mining operations, with sufficient forms, charts, records, and procedure to illustrate how the principles are applied in actual practice. From it one can find how to determine the current expense, prepaid expense, and asset or capital charges, how to determine the current and accrued income by means of production accounts, sales and receipt accounts, and inventories, so as to conform to the requirements of the Treasury Department's regulations governing the making of income-tax returns. It will be found of considerable value to auditors, treasurers, comptrollers, and other directors and executives of mining companies. The contents of the book are as follows: Section I. Promotion, Development, and Equipment. Section II. Operating Production. Section III. Administrative Accounting. Section IV. Cost Accounting.

Elements of Specification Writing. By R. S. Kirby. vii + 153 pp., John Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price $1.50.

This is the second edition of a treatise on the art of writing specifications and is the outgrowth of a series of lectures delivered before the senior class in civil and sanitary engineering in the Sheffield School of Yale University, in which institution the author is assistant professor. The following features are worthy of note: The fundamentals of a contract, particularly of a construction contract, with its attendant plans and specifications, are given. A chapter is devoted to the advertisement and one to the proposal. The general clauses are given detailed attention; many interesting cases are cited to illustrate their application to actual construction work. Practical suggestions are given that deal with the specific clauses. Outlines of such clauses for nine simple construction projects will assist the student as he endeavors to grasp the composition of specifications. A classified list of references will furnish the student and the instructor with much material for comment and illustration. The new edition contains much new material; the first two chapters have been re-written. The book will be found of value to all those who are interested in the subject.

Concrete Work, Vol. II. By W. K. Hatt and W. C. Voss. 206 pp., ill. J. Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price $2.

This volume has been prepared to develop the practical ability of the concrete worker, the inspector, and the student in technical schools. As the author states in the preface, most of the applications of concrete are founded on a few fundamental principles and operations: computing, selection of materials, mixing, and placing. Once these elementary principles are understood, subsequent applications in diverse construction may be made intelligently, and practices may be modified to suit new conditions. The book is meant to fill the gap between the theory of the engineer and the special technology of the contractor. The following subjects are treated: Section I. Drawing and Computing. Section II. Preliminary to Construction. Section III. Inspection, Proportioning, and Tests of Materials. Section IV. Forms. Section V. Mixing Concrete. Section VI. Reinforced Concrete Construction. Section VII. Sidewalk Construction. Section VIII. Products. Section IX. Walls.

Manhood of Humanity: The Science and Art of Human Engineering. By Alfred Korzybski. E. P. Dutton & Co., New York. 264 pp. Price, $3.

As Count Korzybski states in the preface, this book is primarily a study of Man, and takes into consideration all the characteristics that make Man what he is. An effort has been made to approach the problem from the mathematical as well as from the scientific point of view. It is obvious that, in order to be able to speak about the great affairs of Man—his spiritual, moral, physical, economic, social, or political status—it must first be ascertained what Man is. Although care has been taken to avoid vague terms, and although the book may seem critical of things metaphysical, it has been written with a desire to find the source of the qualities of mind, soul, and spirit, to measure their scientific significance, and to adduce scientific proof. By doing so, they may be studied without the digressions and misinterpretations that are caused by the personal emotions. The contents of the book are as follows: I. Introduction: Methods and Processes of Approach to a New Concept of Life. II. Childhood of Humanity. III. Classes of Life. IV. What is Man. V. Wealth. VI. The Capitalistic Era. VII. The Survival of the Fittest. VIII. Elements of Power. IX. Manhood of Humanity. X. Conclusion. There are three appendices, on (1) Mathematics and Time-Building; (2) Biology and Time-Building; and (3) Engineering and Time-Building.

Aircraft Handbook. By Fred H. Colvin and Henry F. Colvin. Pp. 415, illus. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $4.

The first edition of this book was compiled under the stress of war conditions; it was not a complete study of the question but, nevertheless, it was used extensively, both at home and abroad. The development of aircraft during and since the War has necessitated a thorough revision. Aviation today is much more a matter of science and certainty than before. The increasing use of instruments, both for navigation and for the information of the pilot has involved the addition of a new section. International air laws are in force; extracts are given. A large amount of technical detail is included. The contents are as follows: 1. Simple Airplane Theory. 2. General Construction. 3. Woods for Airplane Construction. 4. Propeller. 5. Rigging the Plane. 6. Notes and Instructions to Government Inspectors of Airplanes and Airplane Engines. 7. Airplane Engine. 8. Characteristic American Airplanes. 9. Assembling the Curtiss JN4. 10. Liberty Motor. 11. Table of Characteristics of American Airplane Engines. 12. Curtiss OX Engine. 13. Curtiss C6 and C12 Engines. 14. Hall-Scott Airplane Engines. 15. Wright-Hispano Engine. 16. Gnome Airplane Engine. 17. Instruments. 18. Extracts from International Air Laws. 19. Landing Fields. 20. Military Equipment. 21. Airplane Standards. 22. Trouble Shooting for Airplane Engines. 23. Tables and Diagrams. 24. Nomenclature.

Elements of Engineering Geology. By H. Ries and Thomas L. Watson. John Wiley & Sons, Inc., New York. 5½ by 8½, 365 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.75.

This book emphasizes the practical application of the problems of a geologic character that confronts the engineer in almost every branch of his profession. It is more than a condensation of the author's larger text, 'Engineering Geology'; it is the result of the complete re-writing of many parts of the larger book and the amplification of other parts. Those who may require a smaller volume to meet the requirements of a briefer course will find this a reliable textbook. The contents are as follows: The Important Rock-Making Minerals. Rocks and their Relations to Engineering Work. Structural Features and Metamorphism. Rock-Weathering and Soils. Development Work and Control of Rivers. Underground Water. Land-Slides, Land Subsidence, and their Effects. Relations of Wave Action and Shore Currents to Coasts and Harbors. Origin and Relation of Lakes and Swamps to Engineering Work. Origin, Structures, and Economic Importance of Glacial Deposits. Road Foundations and Materials. Ore Deposits. Appendix A: Geologic Column.

American Sulphuric Acid Practice. By P. DeWolf and E. L. Larison, with a chapter by W. M. LeClear. McGraw-Hill Book Co., Inc., New York. 270 pp., ill. For sale by the 'Mining and Scientific Press'. Price, $3.50.

As stated in the preface, the writers' purpose in preparing this volume has been to provide fundamental information for the man with little preliminary knowledge of the subject. It does not pretend to cover acid manufacture with the thoroughness of Lunge. Sullivan's 'Handbook' deals with the laboratory end so satisfactorily that his methods are recommended by the authors, and laboratory practice is not included in the present volume. The subjects dealt with include: alchemy, history, development, status; elementary chemistry of sulphuric acid; characteristics and uses; raw materials; production of sulphur dioxide; brief description of the chamber process; dust-settling apparatus; the Glover tower; Guy Lussac towers; the chambers; acid circulation; introduction of nitre; draft; testing; operation; concentration; outline of the contact process; purification of gases; converting; absorbing; converter mass; accounting. The appendix contains many useful data, and the book will be found of value to all who are interested in the manufacture of sulphuric acid.

Heat Treatment of Soft and Medium Steels. By Federico Giolitti. Translated by E. E. Thum and D. G. Vernaci. Pp. 363, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $5.

This is probably the most complete discussion of the theory and practice of the heat treatment of soft and medium steels that has ever been published. Particular attention has been paid to the effect of various impurities and addition agents upon the properties of the finished steel, and special emphasis is placed upon the fact that commercial heat treatment of steel depends primarily upon the diffusion of carbon and other soluble substances contained, gaseous or solid. The principal headings under which the text is divided are as follows: The Phenomena of Diffusion in Primary Solid Solution; Effects of Diffusion Upon Secondary Crystallization; Diffusion in Austenite as Applied to the Heat Treatment of Steels; Preliminary Heat Treatment of Steel Castings; and Preliminary Heat Treatment of Forged and Rolled Steels. The book is well illustrated, and the translators have performed their part of the work creditably; it should be in the hands of everyone engaged in the heat treatment of soft and medium steels.

Engineering of Power Plants. By Robert H. Fernald and George A. Orrok. McGraw-Hill Book Co., Inc., New York. 595 pp., illus. For sale by 'Mining and Scientific Press'. Price, $5.

In the preface to the first edition of this treatise the authors stated that the material was compiled for use at the Case School of Applied Science, and was used later at the University of Pennsylvania as the fundamental course in power plant work for all senior engineering students, including mechanical, electrical, chemical, civil, and mining engineers. Besides offering much general material relating to the engineering of power-plants, the underlying thoughts in the preparation of the book were (1) to bring the student a realization of the fact that engineering, although based on the exact sciences, is not in itself an exact science; it requires, on the part of the successful engineer, a natural fund of common sense, and the application of engineering judgment; (2) to give the student some idea of the commercial side of engineering work. It will be found an important reference book for practising engineers; the present edition, the second, brings the material abreast of modern developments.

Ceramics. By A. Malinovzsky. D. Van Nostrand Co., New York. 274 pp., illus. For sale by 'Mining and Scientific Press'. Price, $3.

This little book discusses the weathering, the soaking, the molding and drying of clays, and other technical phases of manufacture. Refractory wares are described; defects are classified and remedies are proposed. Actual reference to the subject of ceramics occupies only a small proportion of the contents. The remainder of the book discusses qualitative and quantitative analysis, as well as a number of subjects indirectly connected with the industry. Tables of logarithms, and other information, are included.

Wilson's Mining Laws, 1921. By Calvert Wilson. Pp. 240, paper. For sale by 'Mining and Scientific Press'. Price, $1.50.

This useful treatise contains a summary of the mining laws of the United States, Arizona, California, Colorado, Nevada, Oregon, and Utah. General legal information is also given, with models of forms necessary. A complete index is provided.

Recent Publications

The Geology of Coke County. By J. W. Beede and W. P. Bently. Bull. 1850, University of Texas, Austin, Texas, 1918. 80 pp., index, ill., maps, diagram.

Commercial Possibilities of the Union of South Africa. Issued by the National Foreign Trade Council, India House, Hanover Square, New York City. 31 pp., map.

Coke in 1918. By C. E. Lesher and F. G. Tryon. II:37, U. S. Geological Survey, 1921. 90 pp., table of production. From Mineral Resources of the United States—Part II.

The New Salem Lignite Field, Morton County, North Dakota. By Eugene T. Hancock. Bull. 726-A, U. S. Geological Survey, 1921. From Contributions to Economic Geology, 1921, Part II. 39 pp., ill., map.

Preliminary Report on Petroleum in Alaska. By George C. Martin. Bull. 719, U. S. Geological Survey, 1921. 80 pp., ill., index, maps. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 50 cents.

REVIEW OF MINING

MEETING OF SAN FRANCISCO SECTION OF THE A. I. M. E.

Four valuable papers relating to sundry phases of the application of electricity to mine operation were the feature of the monthly meeting of the Institute held on Friday evening, September 23. The meeting was held jointly with the local section of the Electrical Engineering Society. The papers were: 'Rates of Electricity in Mining Industry', by R. E. Fisher; 'How Operations About a Mine or Metallurgical Plant Can be Scheduled to Fit a Power Contract', by B. B. Beckett; 'The Application of Electric Equipment in Connection With Mining and Milling Operations of the Alaska Gastineau Mining Company', by B. L. Thane; and 'Prevention of Electrical Accidents in Metal Mines', by R. L. Eltringham.

MINING CONGRESS CONVENTION AT CHICAGO

The twenty-fourth annual convention of the American Mining Congress will be held in Chicago from October 17 to 22. In conjunction with the convention there will be held the National Exposition of Mines and Mining Equipment. Among the important questions that will be discussed are the following: The relationships between the railroads and the mining industry, the legal responsibility of labor unions, the benefits or disadvantages of co-operative organizations through a modification of the Sherman Anti-Trust Law, the proper protection of our home industry, the establishment of wise methods of taxation, the increased utilization of metal products, and the development of American interests abroad.

The official announcement of the convention says:

"The twenty-fourth convention of the American Mining Congress will be dominated by a single purpose—to create through its conferences and discussions a program which will represent the needs of the mining industry and which will benefit the nation in the establishment of efficiency and economy in mine production and in the conservation of our great natural resources. Every mine executive, every mine operator and official, every trade and commercial organization, every engineer or teacher, everyone interested in furthering our industrial development is invited to participate in this convention as a partner in an effort to bring about a revival of the mining industry as a means to national prosperity."

In addition to Alaska and Mexico, the States of Arizona, California, Colorado, Oregon, Utah, and Wyoming will be represented by attractive exhibits. There will be about 200 representative exhibits, illustrative of the latest forms of mine-machinery and mine-equipment, at the exposition. It will furnish the mine operator and official a unique opportunity to study the equipment that they need in furtherance of efficient operation. The headquarters will be at the Congress hotel.

IMPROVED OUTLOOK FOR THE AMERICAN SMELTING & REFINING CO.

A slight improvement is reported in the affairs of the American Smelting & Refining Co. The first half of 1921 was not profitable, although the diversity of business helped somewhat at a time when the copper mines were closing down. With its payroll reduced and the cost of materials decidedly lower, the company has been reducing its losses. From silver and lead, it has been enjoying a rather steady income and some profit, while its copper business has suffered from the low prices at which the comparatively few sales have been made. The company has been producing between 4,500,000 and 5,000,000 oz. of silver monthly, of which about 60% has been derived from foreign sources and 40% from domestic ores. The foreign silver has been sold in competition at the open-market quotations of between 50 and 65c. per ounce. Silver from domestic ores is sold to the United States Mint at $1 per ounce.

The company has also been a buyer of much of the German silver, which has been brought to the United States from time to time. Its copper production has been averaging about 3000 tons monthly or about one-half its normal output. Since the beginning of the year, when it gave up the sale of all metal but its own, the company has been marketing its copper as produced, so that today it has no unsold surplus from 1921 operations. It still has an accumulation of copper from 1920 to be marketed.

It is believed that the preferred stock will remain in the ranks of the dividend payers even though it be necessary again to dip into surplus account.

BINGHAM MINES COMPANY IS OPERATING AT A GOOD PROFIT

The Bingham Mines Co. has made an excellent showing on its operations in Utah this year. In the first eight months, with August estimated, the company's profits and its equity in those of the Eagle & Blue Bell company have been at the annual rate of $228,594, or $2.29 per share, before allowance for depletion, depreciation, and taxes, and $49,975, or 41c. per share, after these charges. The physical condition of both the Eagle and Victoria properties is better than ever before. Recent development at the latter has disclosed an orebody containing high silver content which has been proved to extend continuously from the 1350-ft. to the 1700-ft. level, running from 4 to 14 ft. wide. This is one of the best orebodies recently opened in the Tintic district. In the past twelve years the Bingham Mines Co. has paid off $1,500,000 of indebtedness, purchased two properties for over $1,000,000, and paid dividends of $675,000, with a net increase of only $54,510 in capitalization.

GOLD MINING ON THE MOTHER LODE IS FLOURISHING

That conditions along the Mother Lode in California have improved materially and that prosperity in gold mining is on the upward climb is the statement made by Stanley Arnot, superintendent of the Plymouth Consolidated mine, one of the steady producers of Amador county. Arnot states that the cost of materials used in mining are continuing the drop that has been in progress for some time and that labor again is abundant. These two conditions have served to bring about a revival of operations by some of the big producers of former years that were compelled to suspend during the War, and to cause new development

in some properties that have not operated for a long time.

The Plymouth mine, with its 30-stamp mill and re-grinding equipment, is declared by Arnot to be handling a larger tonnage of ore than any other mine in Amador county. Three hundred tons of quartz is being crushed each day in this plant. The ore is low-grade. The Plymouth mine is working with a crew of 200 miners and mill-men.

Discussing conditions throughout the county, Arnot said the Kennedy mine had resumed operation. This mine, near Jackson, has a 100-stamp mill. While the company has resumed operations following a long shut-down due to a fire and following flood, it will be operating on a larger scale soon. The Argonaut mine, companion to the Kennedy, which was also closed by fire and flood, has been operating for some time. Fifty stamps are dropping at present and more will be falling soon.

Development work of an important nature is being done in the Fremont mine. Eyes of Mother Lode mining men now are turned to operations in the Moore mine near Jackson. This mine, said to have been sunk to a depth of about 500 ft. 25 years ago, is being re-opened. Machinery has been installed and the unwatering of the shaft now is in progress. It is understood these operations are based upon reports as to ore conditions in the mine when it was abandoned years ago.

MARKET FOR LEAD ORE AT JOPLIN SHOWS IMPROVEMENT

Sales of zinc ores in the Joplin district during the week ended September 10 approximated 3600 tons, the prevailing price-scale being $19 to $20 for first grades. There were a few sales at $18 and $18.50, but this was confined to less desirable ores. There were no sales of calamine. Shipments slightly exceeded purchases and the general market trend seemed a trifle stronger than the previous three-week period. The lead-ore market was decidedly stronger, prices advancing to $55 for 80% grades and the demand appeared unsatisfied at the week end. The market for lead ores was apparently strengthened by the fact that the Ontario smelter, which had been down for some time, again started operations, and the other large consuming interests seemed to be utilizing a larger ore-supply than previously.

The fall months opened with considerable eagerness on the part of ore-producers to do everything in their power to maintain operations at plants that are running or even to increase the number, providing it can be done without capital investment. The unemployment situation has been serious for many months in the field, and only the migration of labor to the harvest fields of Kansas, Nebraska, and the Dakotas made the situation tolerable during the summer season. With the closing of these seasonal industries it is expected that a considerable portion of the labor that had migrated will return and add to the unemployment problem of the field. A canvass of the district last week disclosed 3070 miners employed at underground operations. This total compares with a normal employment of 12,000 to 15,000 men by the zinc and lead industry of the three States.

ARIZONA

Bisbee.—At the Calumet & Arizona property 300 men are still on the payroll; a like number is employed at its associate mine, the New Cornelia. Considerable development work has been under way in both properties, while advantage is being taken of the suspension of production to do some needed repair and improvement work in the shafts at Bisbee. The new Campbell shaft has been concreted down almost to the 16th level, the shaft having been completed and bottomed at 1700 ft. At the Junction shaft the concrete pipe-line is installed from the 2300-ft. level to surface. This shaft, which handles most of the water for the entire Bisbee basin, is lifting about 3200 gal. to the surface every minute. New Cornelia is producing in a limited way, it having been found inadvisable to close the leaching-plant entirely. Operations at both properties are being conducted at a loss. Experiments are being carried on at the Calumet & Arizona's 85 mine in New Mexico, and at the Verde Central property at Jerome.

Jerome.—The development program that the Shannon Copper Co. is carrying on at its Yaeger mine and its property at Gleeson is exposing better ore than was being uncovered several months ago. While no ore has been shipped from either property for some time, due the smelters being closed, the stock-piles are steadily growing larger, which will mean a substantial sum to Shannon just as soon as shipments start. On ore that is now being taken out of the Yaeger mine, Shannon could today show a profit even with the metal at current low prices. Shannon continues in an unusually strong financial condition. It has between $390,000 and $400,000 of net quick assets, equal to better than $1.30 per share on the stock. Expenses at the Yaeger and Gleeson properties are averaging between $3000 and $4000 per month.

CALIFORNIA

Cima.—Promising gold discoveries have been made in this vicinity. The veins are said to be in quartz, and, besides gold, contain silver and lead. Claims have been staked along the strike of the lode for a distance of about five miles. E. J. Ginn was the original discoverer.

French Gulch.—The Atascadero Copper Co. has purchased the Greenhorn group of copper claims situated three miles west of Tower House. The final payment of $50,000 was made recently. The claims were located in 1916 by Henry B. and J. F. Warren.

Grass Valley.—The Malakoff hydraulic mine, near North Columbia on the San Juan ridge, is to be re-opened immediately. The project is in charge of Abe Hall, a well-known mining man here. He is said to be backed by a group of mining engineers and mine officials of this district. The mine produced many millions by the hydraulic process, but was closed by the Sawyer decision of 35 years ago. For several years it has been under control of W. B. Bourn and associates, who made no effort to work the deposits. The new operators plan to sink to bedrock and then drift along the channel to the point where gold deposits are believed to exist.

La Grange.—The La Grange Gold Dredging Co. has contracted with the Yuba Manufacturing Co. to erect a dredge that will cost approximately $185,000, to mine its property in this vicinity. Shops and derricks are being erected by the Yuba company preparatory to starting construction.

Placerville.—O. A. Ingraham is operating a 5-stamp mill at the Havilla mine, at Nashville. New ore of good grade has recently been developed.

Randsburg.—The Pittsburg & Mt. Shasta Mining company has purchased the Black Hawk mine. Emil Jonsen will be in charge as general manager, D. A. McCormick, of Keswick, long connected with the company, will be its superintendent. The company, which has interests in the copper belt of northern California, is one of the strongest organizations that has yet entered the Randsburg district. It is understood that development will start at once on the Black Hawk and adjoining claims.

Tuolumne.—At the Phoenix mine, lying south of the Providence, a surface plant was put in operation on September 1. James Leary, who is in charge of the work, will commence sinking as soon as the shaft is unwatered.

COLORADO

Cripple Creek.—The Ajax Mine Leasing Co. has taken a

long-time lease on the Ajax mine. The Ajax property is said to be only superficially developed, although a production of $5,000,000 is recorded. A number of sub-leases have been let to experienced miners, and shipments have started. H. C. Colburn is superintendent.

IDAHO

Coeur d'Alene.—The Ajax Mining Co., owner of 13 patented claims, in the Lalande district, will drive an adit into its property from the lowest point obtainable in Burke canyon, according to A. C. Bixby, mine manager. A site has been acquired at a point within a few hundred feet of the main highway to Burke, and about a mile east of the town. The erection of buildings and the installation of machinery will be started at once. The cost of developing the mine by a shaft became a problem, considering the increasing expenses, such as electric pumps, transporting timber and supplies up the mountain, and operating hoists and pumps. With the knowledge that a deeper tunnel eventually would be necessary, it was decided to drive a tunnel now.——The Chicago-Boston Mining Co. proposes to change its name, increase its capital stock by 1,000,000 shares, and buy the property of the Kill Buck Mining Co. with the proceeds, according to notice to stockholders from Donald A. Callahan, president. The capitalization of the Chicago-Boston is 1,500,000 shares, all of which is outstanding. The Chicago-Boston is driving east on the 400-ft. level to pick up the ore found on the 200-ft. level.

Hailey.—The Federal Mining & Smelting Co. has purchased the Baltimore group, an old-time producer in the Wood River district adjoining the Independence. The company has commenced drifting from one of the lower levels of the Independence into this ground. Recent discoveries of new ore have been made. The Independence has been producing almost continuously for about three years.——The Bunker Hill & Sullivan company has been conducting active mining operations for more than 30 days. That the company is well satisfied with the possibilities of the district is evidenced by the options it has taken on adjoining ground and its negotiations for two properties in the same locality. It has erected substantial buildings and is using electric power from a seven-mile transmission line run from Hailey for its benefit.——The Mascot Mining Co., recently organized, has installed a 50-hp. hydro-electric plant, a new sawmill, and additional equipment. Active development with 10 men has been commenced.

MICHIGAN

Houghton.—It probably will be spring before new hoists are installed in the Seneca and Gratiot shafts of the Seneca property. The matter of new hoists is soon to receive the attention of the directors. In the meantime, development of the Seneca branch will continue. Until the Centennial-Allouez resumes operations, Seneca will continue to have the use of the Baltic mill. Drifts are being pushed forward from the four lower levels of Seneca, northward in the direction of Gratiot with which they ultimately will connect. Copper content varies, but on the whole is satisfactory and averages well with Kearsarge lode 'rock' in neighboring mines. Stoping continues on the 4th level in an excellent quality of ground.

Power-Plant of the Cumberland Mines Co. at Mayday, Colorado

Directors of the Arcadian Consolidated have decided to continue development work at the property the coming winter, employing a small force. Disclosures in the drift that is being driven south from the 942-ft. level of the New Baltic shaft, to connect with the 900-ft. level of the New Arcadian, continue encouraging. Some minor faulting has been found, but there has been no difficulty in recovering the vein, and the mineralization thus far is described as highly promising. There is no present need of additional financing and this matter will not be taken up until a later date.

Despite the fact that the majority of the mines have been closed for five months there is little evidence of distress in the district. Public relief agencies report that requests for aid are not unusually frequent and as a matter of fact the Houghton County Poor Commission paid out for relief less money, by $1000, in August this year than in August 1920. An extensive highway-construction program has worked well as a relief measure and in addition to this several hundred men have been given work in extending the Calumet & Hecla water-main from Calumet to Ahmeek and also from Calumet to the Ahmeek mills. There have been no business failures. It is realized, however, that with the cessation of road-work

and other outside operations, it will be necessary to adopt some organized form of relief. The relief organization, which will be largely supported by voluntary contributions, will have its greatest task in the north end of Houghton county or the Calumet district.

MONTANA

Butte.—Increased operating efficiency is being obtained by the Davis-Daly company, for which J. L. Bruce is general manager. It is planned now to have six shifts weekly get out the same amount of ore that formerly required 13 shifts; recently even this ratio was exceeded, more than 400 tons being hoisted. During the War, Davis-Daly hoisted between 250 and 270 tons with a force approximately twice the number at present employed. Costs at present are around $6.20 per ton, contrasted with more than $14 in times past. Another noteworthy saving has been effected in the sorting out of waste and the maintenance of a higher grade in the shipments, this serving to effect an economy of about $6000 monthly.

Cross-cutting is under way on the 750-ft. level of Davis-Daly's Hibernia mine. From the showing of ore on the 600-ft. level and on the 800-ft. level of the Nettie mine of Anaconda adjoining the Hibernia, there is little doubt as to the ab'lity of Davis-Daly to develop ore on the 750-ft. level.

Cooke City.—It is reported that a vein of high-grade ore has been found in the Glengarry mine at Cooke City.

DeBorgia.—After 30 years of inactivity, work is to be resumed on properties of the old Rock Island mine, six miles north of DeBorgia, now known as the Silver Rock, according to Chris Ehrenberg. During early years valuable deposits of silver and lead were found in the old mine. During the summer the new company, composed of Eastern capitalists, has been building three miles of road, making possible the hauling of ore to DeBorgia. Several bridges have been constructed.

Deer Lodge.—The mill of the Champion Mining Co., being operated by the Butte-Jardine Co., is producing 40 tons of concentrate per week. This is shipped to the East Helena smelter, the principal value being in the silver, which averages 250 oz. per ton. The mine is worked through a 1500-ft. tunnel, which taps the old shaft at the 600-ft. level. Approximately 100 men are employed in the mine and mill, and the small town of Champion is flourishing. Miles Blunt is superintendent.

Helena.—The East Helena smelter of the American Smelting & Refining Co. virtually has retired from the customs-ore field in Butte, the explanation being given that Butte ores are proving too silicious for this plant to treat. The East Helena smelter is of the silver-lead type and does not pay for any copper found associated with the silver-lead ores it reduces. It exacts a penalty for zinc above a certain figure.——Mining companies operating in the vicinity of Helena are reporting miners ready to work at $3.50 per day and this lowered wage with the reduced freight-rates on low-grade ores is expected to promote a revival in silver and gold mining.

NEVADA

Divide.—The re-organized Victory company has resumed work following the collection of the first assessment. No work has been done since March. The former work was all done west, or toward the Belcher, from the north-south fault, but now a cross-cut is being driven to open the vein east of this fault, or toward the Brougher. This work is being done on the 200-ft. level. There is exposed from the bottom of a 500-ft. winze an ore-shoot 25 ft. long, 18 in. wide, and assaying $50. John Schweble is in charge of the work.

The Tonopah Divide Co. is shipping 50 tons daily to the Belmont mill at Tonopah; the average of ore shipped last week was $32 per ton. The Divide Extension has been shipping 33 tons daily to the MacNamara mill, averaging $68 per ton.

Eureka.—At the Eureka-Holly Extension the head-frame over the Standard shaft is in service. The shaft has been newly timbered down to the 50-ft. level. The ore found 100 ft. south of the shaft averages $2.06 in gold and 52 oz. silver per ton and 48% lead, according to the assays.—— Two cars of oil have been received by the Eureka-Holly. A connection between the 500-ft. and 600-ft. levels has been made, and the ventilation is thereby improved. A new and good prospect has been found on the 400-ft. level. On the 600 a drift is in progress to cut a block of ore-bearing ground east of the shaft. A fault intervenes and no ground east of the fault had ever been exploited at such depth, but high-grade ore has just been found. A big tractor is in use, hauling ore to the railway depot.

At the Bullwhacker the old Laird stope is being explored below caved ground, and 2 ft. of good lead ore has been cut. Ore is being hoisted for shipment. The 430-ft. level of the Holly is being extended 250 ft. to intercept an orebody in the Bullwhacker.

The Cortez Silver Mines Co., operating in the northern part of Eureka county, has driven the lower adit over 2400 ft. and encountered more than 2 ft. of primary sulphide in a limestone fissure, at a depth of about 360 ft. vertically below the old workings. The ore is reported to assay from 150 to 200 oz. silver and 0.25 oz. of gold per ton.

Gardnerville.—A winze from the lower tunnel of the Veta Grande mine, 12 miles south of here, has cut the ore-shoot exposed in the tunnel. A shaft will be sunk at once from a point below the portal of the tunnel.

Gold Circle.—The Elko Prince mine continues to develop high-grade ore at depth, a winze sunk 60 ft. below the 750-ft. level continuing in good ore. The Big Chief Con., owned by Clarence Berry and associates of San Francisco, has resumed work and may soon begin building a mill.

Goldfield.—The Goldfield Deep Mines has levied assessment No. 3, at the rate of 1c. per share, delinquent on October 22. The shaft passed a depth of 1000 ft. on September 20. Assessment No. 2, the first general assessment, brought $82,442, according to the statement of H. G. McMahon, secretary. The expenditures to September 1 total $179,739, of which $130,054 was for operation, $27,482 for equipment, and $22,202 for properties as follows: Milltown, $10,000; Goldfield Combination, $9045; Diamondfield, $158; office-building, $3000. Under the item 'operation' are administration, $15,334; legal advertising, $7458; development, $3972; legal services, $6264; Atlanta Mines Co. expense, $8683; incorporation expense, $6279; shaft sinking, $72,993; traveling, $1117; telephones and telegrams, $443.

Hornsilver.—The shaft of the Orleans has been sunk 30 ft. below the 580-ft. level and it is being continued at the rate of 3 ft. daily. The only other work being done is the preparation of the levels above the 580-ft. for further development. From the surface to the 400-ft. level the shaft is in the vein, but at the 400-ft. the vein goes far into the hanging-wall side of the shaft, gradually straightening below this level, and it is expected it will be entered again by the shaft at 675 to 700 ft. No further development work will be done until the sinking of the shaft has been completed.

Klondyke.—The Knox Divide is shipping 100 tons weekly from its Golden State property to the Tonopah Mining Co.'s mill at Millers, 15 miles west of Tonopah.

Mina.—The most important discovery since the opening of the main orebody is reported by P. A. Simon, general manager for the Simon Silver-Lead Mines Co. The discovery was made west of the west major fault on the 400-ft. level. While the extent of the deposit has not been de-

termined as yet, both faces of a 15-ft. drift are in ore. Fifty tons of ore hoisted to the surface averaged: gold, 0.04 oz.; silver, 23.24 oz.; lead, 2.9%; approximate value, $27.50.

The Mina Mercury Co. will install two new retorts to supplement the two now in operation. A new deposit of crystallized cinnabar has been exposed; the shaft will be sunk deeper.

The West End company of Tonopah recently has taken over, for a price reported to be $50,000, a group of claims owned by J. M. Krippner and F. J. Barr of Reno, and Martin Fitting and Joseph Jones of Hawthorne. The claims, known as the Mabel group, are on the western extension of the vein in the old Garfield mine, formerly a silver-gold producer. They are 20 miles north-west of Mina. Late in 1919 the men who have sold to the West End made their first shipment. This ore, from the Ida claim, assayed 180 oz. silver and $9 in gold. Other shipments followed and recently five carloads of ore of a total net value of $20,000 was shipped. The West End acquired the claims directly from Sol M. Summerfield and George F. Thompson, holders of an option.

Pioche.—The Prince Consolidated has suspended operations on the 800-ft. level until more powerful hoisting and pumping machinery can be obtained. M. C. Godbe, general manager, is inspecting the mine and it is expected he will make an announcement of his plans soon.

Reno.—The Standard Metals Co. will sink the main shaft from the 300 to the 500-ft. level at once and the mill will be closed while this work is in progress. A stope on the 300-ft. level is said to show five feet of $100 ore.——The Fravel-Paymaster shaft is being sunk to the 500-ft. point.

Tonopah.—Bullion production from this district is at the highest point reached for a number of years; shipments from the mills of the Belmont, West End, Tonopah Mining, and Tonopah Extension, from the second August clean-up, aggregated $267,500. Of this total the Belmont shipped bullion valued at more than $94,000, making its total for August $117,000. The Tonopah Mining and Belmont companies are treating custom ore in addition to that from their mines.——On deeper levels of the Rescue-Eula a large tonnage of good mill-ore has been blocked.

Virginia City.—The Pittsburg Comstock Co., adjoining the United Comstock and acquired recently by H. G. Humphrey and associates, has started work with Al McCoy as manager. A stope near the junction of the Bright Star and Trojan veins in this ground produced $75,000 from above 80 ft. The lower tunnel, 600 ft. long, will be driven to the vein junction. William Sharp is consulting engineer. The United Comstock haulage tunnel passes near the east side-line of the West Trojan claim, belonging to the Pittsburg Comstock Co., at a depth of 1400 ft.; ore developed here will be accepted by the United Comstock at its mill.——The Comstock Silver Mining Co. has developed a considerable quantity of mill ore in its Scheels group, in the Succor vein, one of the best of the rich cross-fissures extending between the Comstock and Brunswick lodes at the south end. The 10-stamp mill on the company's Overland group is to be remodeled and enlarged. George Drysdale is manager and Frank W. Royer is consulting engineer.——A large force of men is engaged in sampling the dumps, surface, and old workings of the middle mines, including all the properties on the lode between the Con. Virginia and United Comstock. These properties are under option to the Boericke brothers of Philadelphia. Harold Boericke has been spending a fortnight at the property in company with Albert Burch, consulting engineer, and R. B. McGinnis, superintendent.

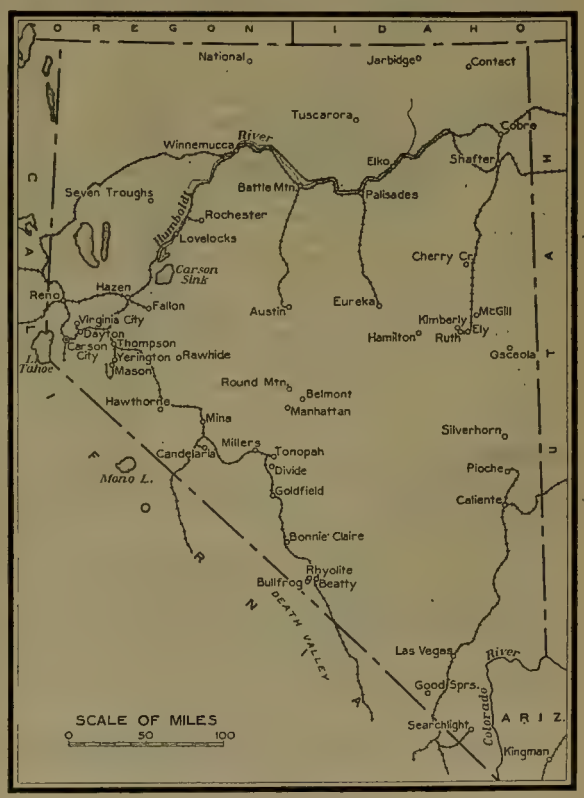
UTAH

Alta.—The shoot recently found at the property of the Alta Tunnel & Transportation Co. continues to improve; the ore is at the top of No. 3 raise and has a width of eight feet. Samples show from $41 to $95 per ton in silver and lead. The ore is a carbonate, easily mined and, owing to the absence of water, can be handled cheaply. F. V. Bodfish, manager, is continuing development work to ascertain the length of the deposit.

American Fork.—A recent heavy rain on the east slope of Boxelder mountain in American Fork canyon exposed a 4-ft. vein of copper ore. The discovery was made by Earl Devey and Arthur McDaniel, who filed on a location.

The American Leasing Co. is now the heaviest shipper in this district. Shipments from their leases average about 70 oz. in silver, with some gold and lead. The Wild-Mercer lease in the Dutchman mine is also extracting ore of good grade. Recently a high-grade lead-carbonate ore was found. This lease has been shipping zinc ore for some time.

Big Cottonwood Canyon.—Encouraging reports come from



Map of Nevada

the Twin Peaks mine in this district, of which S. A. Parry is manager. The tunnel is being driven in a bedded vein, and recent picked samples give assay returns of $3 in gold, 30 oz. in silver, and 5% lead.

Eureka.—E. J. Raddatz, president of the Tintic Standard Mining Co., denies rumors recently circulated to the effect that the mine has suffered several cave-ins and that the chloridizing plant is a failure. These rumors have been circulated in connection with the recent weakness in quotations for Tintic Standard stock. Mr. Raddatz states that about three months ago there was a cave-in, but the shipping records prove that it did not interfere with ore production. As to the mill, for several months past it has been making an average extraction of 83% of the silver, treating an average of 140 tons per day. An experimental plant with a capacity of 25 tons per day has been built recently to save

the lead in the ore. An average of 45 cars of ore is being shipped per week, 65% of which goes direct to the smelter and the remainder to the mill. The company is employing 300 men, and is engaged in an extensive exploratory campaign, according to Mr. Raddatz.

Development work at the Eureka Lily property is being done on the 500-ft. and 1400-ft. levels. The drift on the 500-ft. level has cut bunches of low-grade ore. At present high-grade ore, 18 in. thick, is showing in the face of the drift. Assays of this ore give returns of 39.5% lead, 24 oz. silver, and 60c. gold. On the 1400-ft. level, a rich shoot of ore was recently entered, which assayed 33.8 oz. silver, $12 gold, and 26.2% copper.

Ore shipments for the week ending September 10 totaled 137 cars, as compared with 155 cars for the preceding week. The Tintic Standard shipped 42 cars; Chief Consolidated, 34; Victoria, 14; Dragon, 10; Eagle & Blue Bell, 9; Iron Blossom, 6; Swansea, 5; Centennial-Eureka, 4; Gemini, 3; Iron King, 2; Colorado, 2; Bullion-Beck, 2; Mammoth, 2; Gold Chain, 1; and Sunbeam, 1.

Koosharem.—Preparations are being made by C. D. Ray of Salt Lake City and associates to resume work at the Indian Red Paint mine in Sevier county, near here. The deposit at this property is a deep red clay, with an aluminum base, and almost entirely free from silica. The deposit is said to be one of the best of its kind in the United States, and the owners of the property have made a favorable contract with calcimining concerns on the Pacific coast. The deposit is near the surface and can be excavated with scrapers.

Logan.—Work is to be started at the property of the Mineral Point Copper Co. in East Paradise canyon, according to Andrew Madsen, superintendent. Some time ago a tunnel, 282 ft. long, was driven at a shallow depth. Recent work cut 20 ft. of gold-bearing quartz. One hand-picked sample gave returns of 77.2 oz. gold and 6.6 oz. silver. The property is about seven miles from a railroad.

Park City.—Ore shipments for the week ending September 10 totaled 1354 tons, of which the Judge companies shipped 524; Silver Coalition, 442; Ontario, 388. Shipments for the previous week were 1914 tons.

Salt Lake City.—A brief report has been compiled by Carl A. Allen, district mining engineer for the U. S. Bureau of Mines, at the request of officials of the Bureau at Washington, on the present status of employment in the mining industry. Allen states that at present the three smelters operating in this State employ 1300 men, as against 2300 a year ago, 2500 two years ago, and 5000 employees three years ago. The working forces in the Park City and Tintic mines are about normal. Very few men are applying for work at the mines and there is even a scarcity reported of good machine-men. Mr. Allen's investigations lead him to believe that most of the men thrown out of employment by the closing down of the Utah Copper, Utah-Apex, and Utah Consolidated properties at Bingham obtained work on farms and in road construction, although a large number have left the State.

BRITISH COLUMBIA

Alice Arm.—A body of high-grade ore is reported to have been opened up on the Silver Standard and the same may be said both of the Queen and the Moose properties.

Hope.—The Eureka mine, situated in the Cheam mountains, and one of the oldest lode mines in the Province, has been re-opened. Messrs. Sperry and White, of Vancouver, have acquired control of the property and are planning to invest from $75,000 to $150,000 in development and plant. Confidence is expressed that the old property will become a large producer of silver.

Princeton.—The Princeton Mining & Development Co. is engaged in the opening up of a promising property situated east of the town of Princeton. The ore contains copper, gold, and silver. The richer orebodies have given returns of: copper, 16.9%; silver, from 2 to 12 oz.; and gold, from 45c. to $2.50. Three tunnels have been driven and mine plant and accommodation has been provided.

Stewart.—The Portland Canal Mines Co. has been organized in the United States, as a holding company for the Daly Mines, Ltd., in British Columbia, to take over and operate the Big Missouri mine. T. H. Wilson, of New York, and Pat Daly are at the mine in consultation with regard to future development. Exploration work is to be started at once and continued through the winter, Pat Daly acting as superintendent.——Grant Mahoot has struck rich ore at the Divide group, at the head of Salmon river. Assays of some of the best ore have run up to more than 2000 oz. in silver per ton.——R. L. Clothier has a crew of men at work on the trail and is cutting brush for the new tramway at the Silverado group. Some 500 ft. of snow-shed is being built. Work is being rushed with a view to keeping the mine in operation during the winter.——The new wharf that was built last year by the Dominion government is altogether inadequate for the business of this place. It is to be extended at once and the warehouse on it is to be enlarged.

Trail.—The ore receipts for the week ended September 1 at the smelter totaled 6552 tons, 6287 tons coming from the Consolidated company's mines. The other shippers were: Josie, Rossland, 89 tons; Knob Hill, Republic, 77; Little Maime, Ainsworth, 11; Paradise, Windermere, 45; and Spokane-Trinklet, Ainsworth, 43. The Consolidated company has suspended production at its Sullivan mine, at Kimberley, temporarily, in order that repairs to haulageways and other parts of the mine may be made. The single men have been laid-off and the married men are doing the repair work. It is expected that production will be resumed within a week.

MEXICO

Chihuahua.—La Nortena, a group of 15 mining claims, situated on the Roncesvalles hacienda, in the municipality of Las Cuevas, has been taken over by Ramon C. Reyes. The ores of this district contain gold, silver, and lead.——Carlos Perez has filed with the mining agent at Chihuahua city application for the Guadalupe group of mines, situated in the Guadalupe mountains in the municipality of Aldama.——Some new silver-lead properties have been located by Hilario Perez, to be titled under the name of La Reina del Cobre. The survey is being made by Jose M. Licona of Chihuahua.

Activity is also noted in the Chinipas district where Charles Ballow, representing Albert H. Davison and George Johnston, is operating extensively. Ballow has recently located three different groups in that vicinity, the Santa Rita, situated in the Santa Barbara camp, the Elena, and the Santa Barbarita, all of which contain bodies of gold and silver ores. Some of the old workings will be cleaned out and new shafts will be sunk on the principal veins which traverse the properties.

Las Chispas.—A shipment of 121 tons of ore and concentrate by the Minas Pedrazzini Gold & Silver Mining Co. was made during this month. The ore is freighted by mules and burros to Nacozari, the nearest shipping point. This shipment will net about $65,000. Steady shipments have been made for over two years, approximately 500,000 oz. of silver and 2800 oz. of gold having been produced.

Nacozari.—The La Gran Republica, Lady Goodlander, and Tres de Abril claims are being opened up by the Sonora Development Co. of Kansas City, Missouri. This property is situated about four miles east of the Pilares mine of the Moctezuma Copper Co. and was worked in several places by the Spaniards. Several bodies of high-grade ore have been mined during recent years. Work has been pursued during the past year to develop low-grade ore for milling purposes.

The ores carry gold, silver, lead, and copper. R. W. Brown is manager.

Saltillo.—The State of Coahuila has placed a tax on all ores mined in the State, the tariff being as follows: gold and silver, 2% of the gross value; copper, 1½%; lead, 1½%; and zinc, 1½%. The tax is to be paid on the gross production, the price of mining and freight and treatment-charges are not to be deducted.

Leopoldo de la Pena is developing some zinc mines in the Mimbre canyon near Parras. There are six claims in all composing La Esmeralda group.

The delinquent share-holders of El Destino Mining Co. are advised that unless all over-due assessments are paid within the next 15 days the stock will be declared forfeited. Payments may be made to Manuel V. Valdez, treasurer of the company, who has offices in the city of Saltillo.

The report of the Temiskaming, covering a period of 18 months ending June 30, during which the company's mill operated only 11 months, shows an operating deficit of $135,765. The net production was $179,294 and other income $51,479, making a total revenue of $220,773, and operating and other charges amounted to $366,539.

Ottawa.—A report issued by the Dominion Bureau of Statistics states that the total gold production of Canada for the first six months of 1921 amounted to 396,391 oz. with a value of $8,194,129, representing 52% of the amount mined during 1920. A feature of the market for gold is that all sales to the Royal Mint at Ottawa are paid for in New York funds. Ontario produced 73.5% of the total Canadian output, British Columbia ranking second with 22.9%, and the Yukon third with 3.3%. Quebec, Manitoba, and Nova Scotia combined produced 0.3%.

ONTARIO

Beaver House Lake.—At the Argonaut about 100 ft. of drifting has been done on the vein found on the 350-ft. level. Assays obtained at intervals of 5 ft. have shown gold content averaging $15 per ton.

Cobalt.—The Nipissing during August mined ore of an estimated net value of $172,931, of which $147,552 was silver and $25,380 cobalt, and shipped bullion from Nipissing, and custom ores of an estimated net value of $236,558. At the second level of shaft 63 a vein was found having a width of 2 to 3 in., which assays several thousand ounces per ton. The Nipissing has taken an option on two Porcupine properties, the Rochester directly north of the Hollinger, and the Edwards claim a little east of the Dome. Diamond-drilling on both is in progress.

The La Rose is drifting on the new high-grade vein on the Violet property at the 570-ft. level. The vein is widening out considerably and shows increased enrichment as it is followed.

Porcupine.—It is officially stated that the Dome Mines is now treating an average of 840 tons daily, recovering approximately $6.17 per ton. Adding the premium of American funds this gives an income of approximately $6.80 per ton or at the rate of $5712 per day.

The report of the McIntyre-Porcupine for the year ended June 30 shows net earnings of $1,088,513, compared with $1,280,232 for the preceding year, the decrease being due to the curtailment of operations during the winter owing to shortage of power. After deductions for taxes and depreciation a net profit of $815,530 was transferred to surplus. Ore was produced to the amount of 171,916 tons of an average value of $11.67 per ton and gross value of $2,005,672. A considerable increase is shown in the ore-reserves, which were estimated at 624,422 tons valued at $6,392,394. J. P. Bickell, president, says "We feel warranted in increasing our milling facilities by the addition of a new 500-ton unit, part of which will be used to bring our production up to 1000 tons of ore per day."

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Max Kraut is at Mexico City.

W. J. Loring is on his way to Boston.

B. M. Snyder is on his way to southern Mexico.

Frank D. Pagliuchi has returned from New York.

Courtenay De Kalb is now residing at New Orleans.

R. W. French, of Oakland, is at Newport, Delaware.

D. W. Brunton is sojourning at Long Beach, California.

R. N. Dickinson has been geologizing in Siskiyou county.

Fred G. Farish has been at Telluride, Colorado, for several weeks.

Walter L. Reid and **R. A. Hardy** have been at Juneau, Alaska.

Walter H. Aldridge is now at 41 East 42nd street, New York City.

L. S. Cates is at Boston, having been called there by the death of his mother.

Harold A. Titcomb has returned from Palo Alto, California, to Farmington, Maine.

F. G. Cottrell is expected at Washington, on his return from Europe, about October 18.

Henry H. Ray is at Nevada City, California, as engineer to the Yuba Development Company.

Herbert R. Hanley has returned to San Francisco from a visit to the smelter at Trail, B. C.

Robert M. Keeney has moved from Leavenworth, Washington, to Somersville, Connecticut.

C. W. Purington arrived at Boston on September 14, and is expected in San Francisco shortly.

W. B. Donoghue, of the Cerro de Pasco Copper Co., Casapalca, Peru, was recently in New York.

Charles B. Croner is at Alpine, Idaho, on special metallurgical work for New York capitalists.

F. E. Calkins, of Globe, has completed his examination of the Lincoln mine, near Prescott, Arizona.

H. Foster Bain and **T. T. Read** will be entertained by the local section of the Institute on Tuesday, October 4.

C. M. MacNeill, president of the Utah Copper Co., visited the company's properties at Bingham and Garfield last week.

E. J. Atckison has returned to Los Angeles from the Bishop Creek Milling Co.'s property in Inyo county, California.

J. Mackintosh Bell has returned from the Alberta oil region and is now at the Keeley mine, near Porcupine, Ontario.

L. C. Penhoel is at Metahuala, San Luis Potosi, Mexico, where he is erecting a mill for the Santa Maria de la Paz company.

Raymond F. Bacon has resigned as director of the Mellon Institute and will be succeeded, in January next, by **E. R. Weidlein.**

H. Hardy Smith writes from Sydney, Australia. He is on his way to South Africa, where he expects to remain for some time.

Morton Webber entertained the Warren District Luncheon Club at Bisbee recently with a talk on the diamond mines of South Africa.

Frank S. Allen, of Silver City, Utah, has been appointed general superintendent of the Knight properties in the Tintic district.

John I. Lane, mining engineer for the American Smelting & Refining Co., has moved from Saranac Lake, New York, to El Paso, Texas.

Gaichi Yamada, Assistant Professor of Metallurgy in the Kyoto Imperial University, has concluded his research into the flotation of coal, at the U. S. Bureau of Mines station at Seattle, and is now at Minneapolis.

Fred B. Ely, together with a party of geologists, has left for the western part of Mexico to make an extensive examination for oil and gas.

O. W. Freeman, professor of geology, has moved from Lewistown, Montana, and is now at the Stockton High School, in California.

Frederick Lyon, formerly vice-president of the U. S. Mining, Smelting & Refining Co., was in San Francisco this week on his way to the Orient.

Henry J. Kruse, of Crosby, Minnesota, has arrived in San Francisco, after traveling in his own automobile from Joplin to Seattle and thence hither.

Oba Wiser has returned to El Paso, Texas, from Kingman, Arizona, where he has been investigating the treatment of the complex ore of the C. O. D. mine.

Frank R. Wicks, consulting engineer of Los Angeles, has returned home after spending the past eight months at the Royal Tiger mine, at Breckenridge, Colorado.

Bailey Willis, Professor of Geology in Stanford University, addressed the Engineers Club of San Francisco on the subject of 'Earthquake Engineering' on September 15.

J. R. Mougin has resigned as Chicago representative for the Mine & Smelter Supply Co., to become mill manager for the Ore Chimney Mining Co., at Northbrook, Ontario.

B. A. Middlemiss, formerly mine manager and, later, assistant general manager for the Chile Exploration Co., Chuquicamata, Chile, has returned to the United States and will take up professional work in this country.

Arthur J. Hoskin has moved from Denver to Urbana, Illinois, where he is Assistant Professor of Mining in the University of Illinois and is engaged in coal-mining investigations in co-operation with the U. S. Bureau of Mines.

E. Roche Rice, previously in charge of the operations of the Van Dyke Copper Co., at Miami, Arizona, is now in partnership with **L. H. Foster**, of Kingman, Arizona. The firm will be known as Rice & Foster, mining and civil engineers.

Tudor S. Rodgers has resigned as chief chemist and assistant superintendent for the Tecopa Consolidated Mining Co., at Tecopa, California, and has opened law offices at Salt Lake City. The firm name will be Rodgers & Rodgers, and they will specialize in mining and corporation law.

E. H. Wells, who conducted special geological investigations for the Chino Copper Co. for the last two years, is the new president of the New Mexico State School of Mines at Socorro. Other newly elected members of the faculty are: **W. T. Quayle**, engineer of metallurgy, a graduate of the Colorado School of Mines; **J. W. Jourdan**, recently professor of civil and irrigation engineering at the New Mexico College of Agriculture and Mechanic Arts; **R. E. Bowman**, who has been chemist for the Cleveland Cliffs Iron Co. and the Republic Iron & Steel Co.; **W. C. Ramlow**, engineer of mines, from the Colorado School of Mines; **C. W. Vaupell**, who was on the geological staff of the Anaconda Copper Co.; and **E. C. Studley**, until recently field-engineer for the Weiland Engineering Co.

OBITUARY

Alton L. Dickerman, one of the foremost mining engineers in the United States, died at his home in Colorado Springs on September 15. He was born in Stoughton, Massachusetts, in 1850. He represented John D. Rockefeller in the development of the iron mines in Minnesota and also was a pioneer in the copper region of Michigan. For years he represented Marshall Field, of Chicago, in Mexico and Alaska. The Hecla and Calumet copper mines also are included in his early discoveries. He is survived by a daughter, Miss Foster Dickerman, of Colorado Springs, and a son Alton L. Dickerman, of New York City.

THE METAL MARKET

METAL PRICES

San Francisco, September 20

Aluminum-dust, cents per pound	65
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25
Lead, pig, cents per pound	4.85— 5.85
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Quicksilver, per flask of 75 lb	$47.50
Spelter, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

September 19.—Copper is quiet and firmer. Lead is active and strong. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 13	65.37	39.62	Aug. 8	61.46	38.62
" 14	65.37	39.62	" 15	60.81	37.02
" 15	64.62	39.37	" 22	61.78	38.29
" 16	65.00	39.50	" 29	62.10	38.10
" 17	65.00	39.50	Sept. 5	62.50	38.10
" 18 Sunday			" 12	63.96	38.98
" 19	65.50	39.75	" 19	65.14	39.56

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59 33	Oct.	119.10	83.48	....
May	107.23	102.69	59 90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Sept. 13	12.00	Aug. 8	11.75
" 14	12.00	" 15	11.75
" 15	12.12	" 22	11.75
" 16	12.12	" 29	11.58
" 17	12.12	Sept. 5	11.72
" 18 Sunday		" 12	11.94
" 19	12.12	" 19	12.08

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 13	4.60	Aug. 8	4.40
" 14	4.60	" 15	4.40
" 15	4.60	" 22	4.40
" 16	4.60	" 29	4.40
" 17	4.60	Sept. 5	4.44
" 18 Sunday		" 12	4.55
" 19	4.60	" 19	4.60

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Sept. 13	4.70	Aug. 8	4.70
" 14	4.70	" 15	4.72
" 15	4.70	" 22	4.70
" 16	4.70	" 29	4.65
" 17	4.70	Sept. 5	4.67
" 18 Sunday		" 12	4.70
" 19	4.72	" 19	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	...
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Aug. 23	47.50	Sept. 6	47.50
" 30	47.50	" 13	47.50
		" 20	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

NICKEL

Financial statements of the International Nickel Co. always have to do with dollars rather than quantities of metal produced or sold, but an insight into the physical end of its business may be gathered from government figures showing a tremendous falling off in receipts of nickel ores and matte into the United States, where the company does its refining. The drop has been more precipitate during the past few months than in the later months of 1920, as July imports were about 2,500,000 lb., against nearly 5,000,000 lb. a year ago. From its high record the arrivals of nickel ores and matte have dropped as follows:

Year ended June 30	Pounds	Value
1919	52,911,658	$9,746,693
1920	36,015,625	6,848,099
1921	22,077,238	4,971,062

In July there was received in this country from abroad but 225,823 lb. of nickel, against 4,649,343 lb. a year ago, and in the seven months to the end of July there had reached here but 2,023,681 lb. in comparison with 25,956,071 lb. in the same period of 1920.

THE MARKET FOR PLATINUM

"Platinum is now firm at $79 per ounce. It was worth $3 in 1893, rose to $158 in December 1919, and fell to $72 in April of this year. A fair minimum, for the next two years at least, would be $100 per ounce." This statement is made by Anim Meluk, a Syrian merchant from Cartagena, one of the Colombian ports on the Caribbean, who, with Carlos Rumie, is now in New York. The two firms, A. & T. Meluk and Rumie Hermanos, purchase and export 70% of platinum mined in Colombia, except that dredged by the Americans, says the 'Boston News Bureau'.

Mr. Meluk bases his estimate for 1922 on these premises: In 1912 Russia exported 300,000 oz., Colombia 12,000, and other countries 1529, total 313,529 oz., an average price for the year of $45.55. In 1919 Russia exported 30,000 oz., Colombia 35,000, other countries 2180, total 67,180 oz., at average price of $114.61. In 1920 Colombia exported 28,757 oz. and other countries 54,124, total 82,881 oz. at average price of $110.90.

A small part of the large amount received in the United States from other countries may be from Russia, but is mostly composed of war accumulations by European governments, now unloading their stocks. During the first six months of this year they sent us 13,771 oz. and Colombia 13,466, total 27,237. Except some very small shipments from Canada—in June, 170 oz.—all new platinum is coming from Colombia now, say, 30,000 oz., against 12,000 in 1912. "The world requires much more platinum than in 1912," says Mr. Meluk. "More instruments of precision are manufactured now, and there is a much greater demand for platinum jewelry. Diamonds look better mounted in platinum, and are safer in that setting.

"Native production in Colombia is diminishing more quickly than is apparent from figures of total production: 35,000 oz. in 1919 and 27,000 in 1921. American dredges mine about 6000 oz. per year. Their output is not decreasing. Native production has fallen with the price from 29,000 oz. in 1919 to 21,000 oz. in 1921, say, 28%.

"Diminution in production must surely continue unless there is an improvement in price. Colombian exporters of platinum do not control the output of the mines. The negroes of the Choco do that. They can always find enough gold to live upon within easy distance of their homes, but platinum is very scarce, and they sometimes waste much time searching for a place where bedrock is not too deep for their primitive methods of excavation. Without the stimulus of a high price they prefer to wash the gravel in the streams for gold."

MONEY AND EXCHANGE

Foreign quotations on September 20 are as follows:

Sterling, dollars:	Cable	3.72½
	Demand	3.73
Franc, cents:	Cable	7.10
	Demand	7.12
Lira, cents:	Demand	4.25
Mark, cents		0.98

Eastern Metal Market

New York, September 14.

The tone of all the markets continues good; as September progresses optimism and business slowly increase.

Prices for copper are a little higher but the volume of buying for domestic consumption is not heavy.

The tin market is quiet and steady.

Lead is in good demand and prices have again advanced.

Demand for zinc is slightly better and prices are a little firmer.

Antimony is a little lower.

IRON AND STEEL

An advance of $2 to $3 per ton in the prices of the American Steel & Wire Co., effective September 10, has broken the long succession of declines in steel products. Prices for wire have been the lowest on the list in relation to cost, and the fact that there has been little cutting in the past two months seemed to indicate an effort to turn the tide. Independent producers have followed the Steel Corporation advances, and all mills made large bookings at the old prices before the advances went into effect.

The heavy influx of wire and wire-nail orders just before the advance showed the country to be bare of stocks to a degree never known. Jobbers covered 60 days requirements while manufacturing consumers in many cases bought for longer periods. Wire fence, in view of low agricultural buying power, remains at the old price.

The Steel Corporation's wire production, in response to the re-stocking orders, has gone up 40% of capacity and promises to increase further. In sheets and tin plate the corporation's rate is still 50%. For all subsidiaries the average is 33%, against 30% in August.

A reduction of 298,000 tons in unfilled orders in August has a more favorable construction than was generally given when it is stated that shipments were 100,000 tons more in August than in July.

That the consumers of independent steel companies also called for increased shipments last month appears from a steel-ingot output for the country in August of 1,351,628 tons. At 27 working days this was 50,060 tons per day, or 31% greater than the daily rate of 38,126 tons for the 25 working days in July.

While reports are not of one tenor, demand on the whole is better than in August, indicating that July was the lowest month of the nine. Apart from wire, prices tend lower, the heavy products, plates, shapes, and bars lagging most.

COPPER

The principal unfavorable feature of this market is the absence of any real domestic buying power. Inquiry is reported as better, but it does not result in purchases except in limited amounts. Foreign buying is good and it is a striking fact that, according to official statistics for the first seven months of this year, Germany not only has been the heaviest buyer, but she has purchased more than the combined purchases of any two other countries. Therefore these statistics confirm a report which has been current in the market for some weeks. Prices generally have stiffened, electrolytic copper for early delivery being quoted at a minimum of 12c., New York, or 12.25c., delivered, from certain sellers with several large producers still out of the market. Lake copper is quoted at 12.25c., delivered, with some sales recorded.

TIN

The week has been a quiet and uninteresting one. Demand from consumers and dealers has been light as compared with previous weeks. There has been a little buying from London when the prices here ruled below parity, and on the New York Metal Exchange there were two sales, one of 25 tons Straits tin for July-August shipment at 27c. and one of 25 tons December delivery at 26.62½c. Spot Straits tin in New York yesterday was quoted at 26.75c. or ¼c. below last week and prices in London yesterday were about £5 below those of a week ago, with spot standard at £156 12s. 6d., future standard at £158 15s., and spot Straits at £157 7s. 6d. per ton. Arrivals thus far this month have been 2075 tons with 2085 tons reported afloat.

LEAD

The feature of the week has been another advance by the leading interest on September 9 to 4.60c., New York and St. Louis, an increase of 10 points. This is the second advance in two weeks. It is stated to have been accompanied by heavy buying so much so that the leading interest is not as heavy a seller as recently. The outside market is quoted at 4.60c., New York, or 4.40c., St. Louis, at which levels a good business is reported.

ZINC

The market is quiet but steady at 4.20 to 4.25c., St. Louis, or 4.70 to 4.75c., New York, with little desire shown by some producers for business at that level. There is no active demand, though some consumers are asking for prompt shipment, particularly galvanizers. One seller regards the market as firmer and slightly higher.

ANTIMONY

There is very little interest in spot or future metal. Quotations are largely nominal at 4.45c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The leading producer continues to quote virgin metal, 98 to 99% pure, at 24.50c., f.o.b. plant, while the same grade from importers is available at 19 to 20c., New York.

ORES

Tungsten: The market is devoid of interest and quotations are nominally unchanged at $3 per unit and upward, depending on the grade of concentrate, the delivery, and the amount.

Ferro-tungsten: This market has undergone no change and prices continue nominally the same.

Molybdenum: There is no business heard of and prices are still nominal at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese Ore: Stagnation rules with high-grade foreign quoted nominally at 20c. per unit, seaboard.

Manganese-Iron Alloys: British ferro-manganese has been reduced to $58.35, seaboard, by one British maker, and others will probably follow suit. Inquiry aggregates about 500 tons in 100-ton and smaller lots, but no inquiry is reported. Spiegeleisen is quiet at $25 to $26 per ton, furnace, for the 19 to 20% grade.

Ferro-silicon, 50%, is quoted at $60 to $65 per ton, delivered, with demand light.

Stocks of crude and refined oil combined, in the United States at present, total 270,261,000 bbl., of which 188,162,000 consists of crude and 82,099,000 refined. Refined-oil stocks include 17,872,000 bbl. of gasoline, 10,358,000 of kerosene, 29,730,000 of gas and fuel-oil, and 6,211,000 of lubricants. At the present rate of consumption, and allowing for three months working supply as a minimum, these stocks are a little more than 4½ months supply.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

HARDINGE COMPANY ISSUES REVISED BULLETIN

Owing to the large demand for literature, the Hardinge Co. has found it necessary to revise Section No. 1 of its No. 7 catalogue, which is now available. This section deals with the principles of operation of the conical mill, and gives a general description of its uses in the industrial, mining, and special fields. Those wishing copies should state in what class of grinding they are interested, in order that they may receive information dealing with their particular class of requirements. In general the advantages of the conical mill are pointed out as follows:

1. Power for a given output is saved as the energy is roughly proportioned to the work performed.

2. The range of grinding for a given size of mill is large, as the different sizes of grinding media and material are segregated, thus presenting no interference with one another.

3. The capacity for a given unit is large, since the ground material is forced forward as soon as produced by the classifying effect of the discharge cone.

4. The wear is slight, as less grinding media are required to effect a given reduction and those that are used do effective work, which saves the lining as well.

5. The conical shape ensures extreme rigidity and simplicity of construction. Mechanical troubles during operation are almost unknown.

6. The physical characteristics and fineness of the product can be controlled, owing to the many different methods of operating the conical mill.

7. The floor-space and head-room required for a conical mill installation is unusually low, due to the compact method of driving and the fact that the mill is self-contained.

8. Owing to the 'truss' construction of the conical mill a great weight of metal is not required to ensure sufficient strength. This lighter construction saves in the cost of transportation; also lighter foundations may be used.

9. The conical mill is a slow-speed mill with very few moving parts and requiring but little lubrication to ensure efficient operation and reducing the possibility of burning out bearings to a negligible quantity.

10. The mill is water-tight when used for wet grinding, and dust-tight for dry grinding, this ensuring a clean and healthy plant.

ENGINEERING TABLES THAT ARE WORTH HAVING

We have seldom seen more information of a practically useful nature packed into 20 pages than we find in a recent publication of the Aldrich Pump Co., of Allentown, Pennsylvania, that has recently come to hand. It is called 'Pump Data 50—Engineering Tables'. It is immaterial who made your pumps; this book will be of inestimable service to you if you have any kind of a pumping problem to solve. The first page, for instance, gives a graphic representation of the distribution of energy from the coal-pile to the pumping unit, by way of the boilers, turbines, generators, transmission lines and motors, and the comparative power cost of operating a pump at 60% efficiency and at 90%. This is followed by tables of 'useful information' that are truly useful. These concern the properties of water and oil, heads and lifts, sundry tables of equivalents, pump-capacities, plunger loads, friction-losses and coefficients, nozzle-discharge, power-transmission, electrical data, pipe data, pumping costs, and sundry other matters, all presented in convenient and usable form.

MINE VENTILATION

Automatic mine-doors, which have been generally adopted as standard equipment by many coal-mine operators, are finding a wide application in metal-mine operation. Whereas a few years ago, automatic doors were looked upon with skepticism by mine operators and in some States were not allowed, today they are recognized as a decided improvement; State laws frequently have been changed to permit of their use. The number of accidents has been reduced by the use of automatic mine-doors and their positive action

Canton Automatic Mine-Door

does not permit of mistakes, loss of time, and contamination of air; moreover such doors have made possible the elimination of door-boys whose work in the past has resulted in numerous fatal accidents to themselves and an inefficient control of the underground ventilation.

The American Mine Door Co. of Canton, Ohio, was a pioneer in the development and application of automatic mine-doors. The inventive genius of N. K. Bowman and the co-operation of progressive mine operators has resulted in the use of automatic doors for a number of years past in the coal and metal mines of both this country and of Europe. The American Mine Door Co. employs ventilation specialists who will advise with mine operators as to their ventilation problems and make recommendation for the proper control of underground air currents.

The automatic mine-door is built upon scientific principles and is thoroughly practical and fool-proof. It will operate under adverse condition, mud and water not excepted, and without the use of that annoying and unsatisfactory evil—the trapper boy.

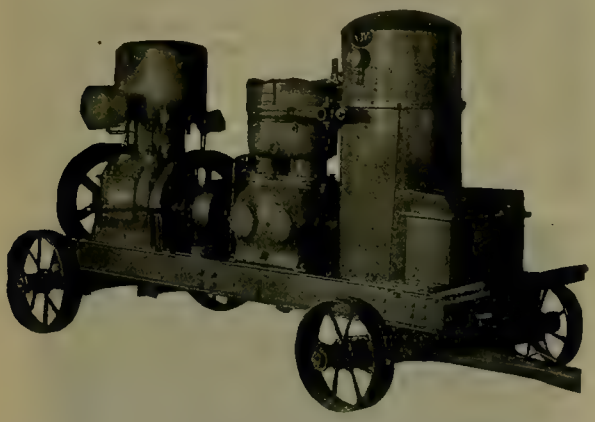
The Canton automatic mine-door is made with the best material and workmanship. Every part is designed and constructed to withstand, with a big margin of safety, the

hardest kind of rough usage. It is constructed in a modern plant and under the personal supervision of men who know just what is required for underground operating conditions. Although designed to be opened by the wheels of the car, the adjustment is so perfect that it opens readily and easily to the man passing through the mine on foot and closes instantly afterward. Under all conditions it is sure to open and sure to close.

In addition to the manufacture of automatic mine-doors, the company makes a complete line of doors for mine use. Doors for man-ways and other underground use which are not automatic but are operated by hand-levers or operating pedals are included. The American Mine Door Co. has published a booklet on mine-ventilation, which contains details regarding the use and operation of mine-doors; this will be sent upon request.

NOVO AIR-COMPRESSOR UNIT

The Novo Engine Co. is distributing its new catalogue, No. 921, just received from the publishers. This catalogue has been revised and brought up to date in all respects, featuring in addition to the line shown in the former cata-



logue new designs of pumps and hoists of large capacities, and an 80-cu. ft. compressor outfit. The latter is assembled with fan and radiator and a forced-circulating water-cooling system for both engine and compressor. It is shown in the accompanying illustration.

ELECTRIC SMELTING OF IRON ORE

By Frank Hodson

Generally speaking, it may be said that where a market exists for either pig-iron or finished steel, in the vicinity of good iron ore and cheap water-power, the electric smelting furnace has a scope. If it so happens, as is the case on the Pacific Coast and in countries where iron is not made, that material used is subject to heavy freight-charges, then the electric smelter is put on favorable terms.

At present all electric smelting furnaces may be broadly divided into two groups—those using open-top furnaces, in which no attempt is made to make use of the escaping gases, and the Swedish 'Electrometall' type of furnace, in which the smelting is done in a closed chamber. The gases and products of combustion pass through a central shaft, through which the charge is fed down to the final reduction zone. The use of these gases materially assists in the quick reduction of the ore and of course is economical, as compared to an open-top furnace. This type of furnace has been in successful commercial use in Sweden and Norway for the past ten years, and large plants with the 'Electrometall' smelter are now being constructed in Italy, Japan, and Brazil.

Some of the furnaces at present constructed have a kilowatt capacity of 5500, but, in the writer's opinion, an improved design of furnace will make it possible to have furnaces of this type of double the present capacity. Interest is now being shown on the Pacific Coast in electric smelting, and as an indication of the immense strides that have been made in Europe in the last ten years in this electric shaft-furnace, I would mention that a total of 27 furnaces installed have a rated kilowatt capacity of 99,700. Brazil is now erecting two of 3000 kw. each, this being the first installation in the Western hemisphere. Others are to follow the present installation. In this respect Brazil is showing steel-men in the United States the vision ahead. The U. S. Electric Steel Products Co. has recently announced its intention of constructing a large electric smelting plant on the Pacific Coast.

'METALKASE' MAGNETIC BRICK

'Metalkase' brick for lining open-hearth and electric furnaces consist of square or round soft steel containers, open at the ends, filled solidly with fine-ground dead-burned magnesite of the highest quality. 'Metalkase' are firmly packed and strongly bonded within the casing and will withstand rough handling. The square sections are 2½ in. on a side and the round 3 in. diam. Both types are made in 9, 13½, and 18-in. lengths.

For bulkheads the round 'Metalkase' 13½ in. long are preferred. They are laid in H. W. R. Co. furnace magnesite, barely moist enough to be worked with a trowel, and with the metal surfaces in contact. The 'Metalkase' are laid the entire width of the bulkhead from the floor-line to the top. There is a decided advantage in building the 'Metalkase' entirely across the wall, as this method of construction reduces to a minimum the cutting action of the gases at the corners and adds to the life of the bulkhead. A water-cooler or a course of chrome brick at the floor-line adds to the life of the bulkhead. A return water-pipe at the base of the cleaning-hole will act as a rest for the scraper and protect the refractories.

In bulkheads they have much longer life than silica; decrease repair costs; reduce the number of hot jobs; diminish the amount of slag in slag-pockets. In port walls they simplify operation by keeping the port section uniform. 'Metalkase' brick have the high melting-point and slag-resisting qualities of magnesite brick; they do not spall; they are unaffected by iron-oxide vapors. Incipient fusion of the exposed ends bonds the face of the wall into a surface which is highly resistant to the cutting action of hot gases and corrosion by slags. No material from an old wall is wasted.

The Schaffer Engineering & Equipment Co. has combined its administrative, sales, and manufacturing departments in its new general offices at 2828 Smallman St., Pittsburgh, Pennsylvania. This arrangement will enable it to render more efficient service to its clients, as the organization will be thoroughly co-ordinated and augmented with additional personnel and facilities. The company's new offices, adjacent to its city factory, have been completed. Removal to the new quarters took place on August 1.

'Volume v. Weight', a new booklet issued by the **Hercules Powder Co.**, presents a phase of the explosive question which the average user very seldom considers. An important point which should not be overlooked is that the bulky explosives, such as Special No. 1 or Hercomite, may show a net saving over costs obtained by using the regular grades of dynamite. Everyone interested in reducing blasting costs should read this booklet. It may be obtained free, by writing to the Advertising Department, Hercules Powder Co., Wilmington, Delaware, or to any branch office of the company.

Mining and Scientific Press

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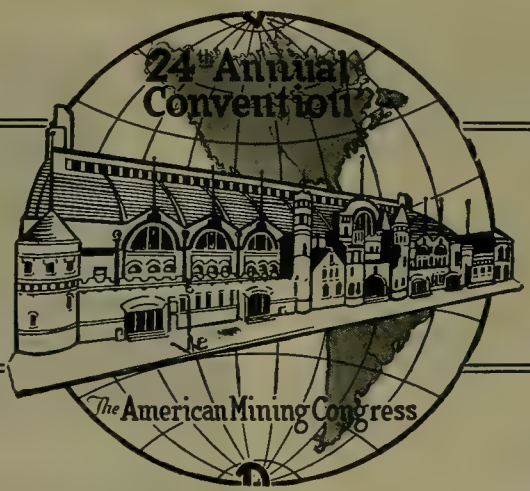

A CONVENTION WITH A PURPOSE: To formulate a constructive program for the Mining Industry.

THE MINING INDUSTRY IS FUNDAMENTAL TO NATIONAL PROSPERITY

The Twenty-Fourth Annual Convention
The American Mining Congress

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T. A. RICKARD, ... Editor

AGITATION plays an important part in flotation; it is essential in many applications of the process. It may be applied indirectly or directly; purposely, or it may result as a concomitant of some phase of pulp conveyance. In the majority of instances it involves expense for power, and careful adjustment; hence the desirability of studying the matter from all angles. On another page of this issue we publish an article on the subject by Mr. Frederick G. Moses, the flotation engineer for the Barrett Company. Mr. Moses' previous connection with the U. S. Bureau of Mines will be recalled, when he made interesting contributions to the technology of graphite and on the influence of colloids in flotation.

DISCUSSION this week includes two letters on the mining law, the first from Mr. L. O. Howard, Dean of the School of Mines and Geology, in the State College of Washington, and the second from Mr. S. A. Knapp, honorably known as a mine operator in California and Nevada. Each treats the subject from a different angle. Mr. M. F. Donahae suggests that a larger use of copper would ensue if the public knew that bronze or brass is cheaper than steel for the making of machinery parts. Mr. Donahae is with the Los Angeles Foundry Company, which, he informs us, "is not in the brass or bronze business". Next comes a thoughtful contribution on the relative merits of electricity and steam as forms of power for use in gold-dredging. This is written by our friend Mr. Leon A. Perret, who is now at Yokohama. An engineer, who desires to remain anonymous, writes on the education of the mining profession. The last letter, from Mr. William Crocker, contains an ingenious suggestion.

METHODS of the ancients, for recovering gold and silver from ores, often formed the foundation on which modern practice rests. Curiosity has been evinced in many quarters as to the customary procedure in Chile and Peru during early times for the recovery of the precious metals, chiefly by amalgamation—a process that is still responsible for the production of more than half of the world's supply of gold. On another page of this issue we reproduce, from a book that was published in London about 100 years ago, an account of the methods of milling and amalgamating that had been evolved by the Indians of those regions. It will be noticed that the operators considered that salt, dung, and warmth were essential to efficient amalgamation. Dung, by the way, is a *sine qua non* in such countries; it is still used throughout the nitrate *pampa* to aid in the clarification of liquors that contain *borra* or slime; its function is, probably, a mechanical one. The amalgamation process described included a fermenting stage; and a simple method of testing showed them whether the *cuerpo,* or moistened cone of concentrate, salt, and dung, had been properly treated, or whether it should be set aside for more fermenting. In the warm summer days the process took from eight to ten days; in winter, three weeks.

OUR contemporary, the 'Journal of Industrial and Engineering Chemistry', apropos of the recent visit of British and Canadian chemists to New York to attend the joint meeting of the Society of Chemical Industry and the American Chemical Society, affirms, *inter alia,* that "the period just before us is pregnant with possibilities of great good, not so much to ourselves as to the lands we love. It is a time for great things. The occasion is here. Unfetter the imagination. Let us plan for the future on the broadest lines, and unitedly set about to accomplish its fulfillment". Again, "The broad basis of sympathetic understanding in each of these joint meetings now in progress lies not so much in a common language as in the fact that in each of our lands the chemist, before the War, occupied a lowly plane in the body politic. He was considered a man apart, no glamor attached to his accomplishments, his opinions were given but scant attention by men in power". We accept the sentiment, for it applies equally well to the mining engineers. As we pointed out in a recent issue, the English-speaking chemists have shown what can be done in coordinating research and advance, and in the avoidance of duplicated effort in technical work; they now set an example of the value of personal contact as a vital factor in sympathetic understanding.

ALTHOUGH the United States has been accumulating gold for a considerable time, it is interesting to note that European governments are not being drained of their reserves of the yellow metal. This fact is emphasized in an analysis of the subject that appears in the current issue of 'Commerce Monthly'. Although over $250,000,000 in gold was received from Europe during the first six months of this year, nevertheless a slight gain is noticeable in the total gold reserve of central banks and government agents there. Only three of the

14 chief gold-holding countries showed a diminution, slight in the aggregate, in their stocks between January 1 and July 1. The net increase among the 11 countries amounted to only about one million dollars. On the other hand, the gold stock held by the Federal Reserve banks in the United States increased by over $400,000,000, or by nearly 20% of the amount held on the first day of the year. Two-thirds of this came from Europe, the remainder from non-European and domestic sources. The increments of gold since January 1 are accounted for chiefly by three streams of metal; one of these comes from Africa, by way of London; one from India, also by way of London; and one probably from Russia, through various European countries. The combined totals of gold received from Africa and India during the period under review amounted to $106,599,000; the exports during the same period amounted to $136,799,000. It is clear, because of small imports into England other than from Africa and India, and because of small exports other than to the United States, that almost all the gold sent here from England was made up of the equivalent of supplies from Africa and India. In addition, $17,200,000 was received direct from British India; it has been estimated that no less than $100,000,000 in Russian gold was imported during the same period. At the outbreak of the War the Russian State Bank held about $800,000,000 in gold; by the end of 1917 this had been reduced to little more than $600,000,000; and it is probable that little remains now. Apart from Russia, Europe is about holding her own as far as gold reserves are concerned. The stock in the United States at the beginning of July was estimated at about $2,461,931,000. Our selling capacity is restricted by the stationary condition of the stock of gold in Europe.

BISBEE, in Arizona, has at least two resources. One is copper, for Bisbee is the centre of the greatest copper-producing district in the South-West—we would say in the world if it were not for the sensitiveness of our friends at Butte. The other, it seems, is climate. Anyone who has spent as much as 24 hours, during the summer, at Phoenix, the capital of Arizona, may demand substantial proof of this assertion. Bisbee is only 150 miles from Phoenix, and that prosperous city is among the five hottest places in the world during a large part of the year. However, it happens that there is a difference of elevation of some 4200 feet in favor of Bisbee, which may account for the ideal climate of that mining centre. Whatever the cause may be, the superiority of Bisbee's 'year-round' climate is vouched for by none other than Mr. A. G. McGregor, resident of Bisbee and known internationally as a designer and builder of smelters. We gather from a speech made by Mr. McGregor before the Warren District Luncheon Club at the Copper Queen hotel that he has turned his talents temporarily to 'industrial engineering', as their profession is styled by the fancy-salaried gentlemen who are showing San Francisco and other cities how to stimulate growth, develop industry, promote civic and municipal prosperity, and, in general, in newspaper phrase, "launch booster campaigns". Mr. McGregor, as might be expected of a real engineer, is specific in his recommendations. The fact that the copper business, unfortunately, is temporarily comatose is no good reason for sitting with folded hands and waiting for 1922; turn to the other asset and realize on it, says Mr. McGregor. "There is not a place anywhere that has a better year-around climate than we have here; there is not a city in the South-West that is more convenient to the undeveloped resources of southern Arizona and Sonora. I believe, with a little effort on our part, we can materially increase our permanent population of independent citizens and also make summer our most prosperous period, instead of the usual dull season when many of our people go to the coast and spend their savings." He proposes a huge out-door swimming pool to provide the bathing that is afforded by the beaches of California. He urges the improvement of the golf-course at the Country Club and believes that opportunity would be created for bigger and better hotels. He advocates increasing the scope of the Summer School of the State University, which now meets at Bisbee; and he sees advantages in consistent and conservative advertising. It seems that the Warren district is composed of a number of small towns with different names; why not change these to East Bisbee and South Bisbee, and call Osburn, the point from which the branch railway leaves the trans-continental line, by its logical name—Bisbee Junction? Convert the Warren District Commercial Club to the Bisbee Commercial Club, arouse the interest of automobile tourists, and take other measures to make Bisbee known to the world, advises Mr. McGregor, who concludes with this sound observation: "A contented, enthusiastic people in the district will mean much to the mining companies as time goes on. It will mean more employees owning their own homes, better efficiency, the working of lower-grade ore; it will mean more intensive development of our wonderful mining district."

A Worthy Purpose

On October 10 a representative gathering of American engineers will assemble for dinner at the Engineers Club of New York to welcome delegates from the principal engineering societies of Great Britain and France. This event will celebrate the return of the mission of American engineers that went abroad this summer to bestow the John Fritz medal upon Sir Robert Hadfield of London and M. Eugene Schneider of Paris; it will also mark the launching of a movement to promote world-wide unity among the English-speaking peoples and among those who co-operated during the War against Germany. The idea of the movement was born during the War, when British and American engineers shared the perils of the battlefield and worked side by side with the French, particularly at the time when the German armies sought to drive the British under General Haig to the coast and win their way to the Channel ports. It is proposed now to establish a new international contact be-

tween engineers on the two sides of the Atlantic, with a view to promoting concord between English-speaking countries, to advance the art of engineering, and to work along conservative lines for the establishment of international peace. The gathering on October 10 is expected also to mark the recognition of the engineer as a factor in constructive national and international policies as well as in the technical field to which he is particularly devoted. For that reason Mr. Herbert Hoover will be one of the honored guests. Enlightened statesmanship will be represented by Lord Bryce and Mr. Charles E. Hughes. Besides these three exponents of international amity there will be present as guests twelve members of the deputation that went to Europe to bestow the John Fritz medal and representatives of the British and French technical societies whose hospitality they enjoyed while on their mission. It is now proposed to establish "a new international contact which shall promote concord among the English-speaking countries, advance the science of engineering, and work along conservative lines for the establishment of international peace". Never was a more worthy purpose announced; gentlemen, go to it, the profession that you represent so worthily is with you, heart and soul. Such a purpose should find support not only among Americans of colonial stock but among all intelligent and serious-minded citizens. We can imagine that it will make its appeal to German-Americans and others whom it is necessary to describe by means of a hyphen, for the movement is not political nor racial; it is the "peoples" that speak English that are asked to co-operate in furthering goodwill, not for political or economic aggrandizement, but to further the ultimate end of civilization, which is to promote the art of living in peace and plenty. Engineers—especially those devoted to mining—are nomadic persons, they make the whole world their field of action, and as travelers, more particularly in the countries where their own language is spoken, they should serve as excellent missionaries in behalf of a greatly useful idea. In a letter to Sir Robert Hadfield, Mr. Calvin W. Rice said: "We, as professional men, must not only have before us the highest ideals of the engineering profession but we must become internationally minded to the end that the peoples of all nations may be joined in the ennobling concept of a common ideal for all professional men throughout the world. It is not necessary to wait for Leagues of Nations to be consummated, and International Tribunals to be effected, before practising what we preach in regard to peace". Nor need we wait for the Disarmament Conference in order to disarm ourselves of sundry provincial prejudices that stand in the way of such co-operation. Already we have set an example in our relations with our good neighbors, the Canadians. Mining engineers in the East as in the West maintain the most cordial relations with our friends across the one international boundary that has neither fort nor sentry to provoke belligerency. Indeed the only guardians to be found there are those whose business it is to check an excessive fraternization by means of the transfer of the spiritous liquors that are under the embargo of the 18th Amendment. The mining congresses and technical meetings that we share with the Canadians are among the best, in contributions to knowledge no less than in good-fellowship. That unfortified frontier is the best augury of international peace; it is more potent in its suggestiveness than any Hague Tribunal or Paris Conference; it is the symbol of good sense. If two energetic and competitive peoples such as the American and Canadian can live side by side in amity and goodwill, then surely it may be hoped that other nations—all nations—will do the same eventually.

Dr. Ricketts of Arizona

At the time of the Panama-Pacific Exposition in San Francisco six years ago the directors requested that each State should select its most useful citizen for the award of a medal. Louis D. Ricketts was designated the favorite son of Arizona. It was a fair and reasonable selection, for Dr. Ricketts has been identified with the mining industry of Arizona in a very special way. In this issue we publish an interview with him, in the course of which he has been compelled to tell the story of his professional career. We say "compelled" advisedly, for whereas he was willing to play golf with the Editor and even to dine with him, he demurred to an interview until we exercised compulsion. It was done in this way. When he declined the honor, as we deemed it to be, we asked him if in the course of his career he had not been assisted, from time to time, by capable and loyal younger men. "Yes, indeed", he replied. "Then", we retorted, "here is your chance to say so in print, where the acknowledgment means something." That settled it. "You have me." The interview was started forthwith. We commend it to our readers as the story of a remarkable career. Dr. Ricketts—for the prefix has clung to him all these years—had the misfortune of losing his father prematurely, but his mother was an exceptional woman, and enabled him to make a good start. To her tenacity and courage, under adverse conditions, he owed his education. Then, in the nick of time, came the fellowship at Princeton that gave him a special knowledge of economic geology and his doctorate in science. The benefactor who founded the fellowship deserves kindly mention, which it is the more pleasant to make because many of us knew W. S. Ward either at Leadville or at Denver, where he was engaged first in mining and then in real-estate speculation. He himself had taken a post-graduate course at Oxford, and in turn, when he had made a little money, used some of it to create opportunities for the younger Princeton alumni by founding the fellowship. He passed the torch; let that be his epitaph. Our subject started his active career as a surveyor at Leadville and then became geologist to the Territory and State of Wyoming. The critical event of his younger years was the contact with Dr. Douglas. How wide has been the influence of James Douglas and how many are the men eager to acknowledge their debt to him! His memory is

kept warm by the kind deeds he did to his juniors in the profession. To Dr. Ricketts the acquaintance and later the friendship with Douglas meant the opening of the doors of opportunity and the stimulating association with a big man. Before, however, he got into his stride, as it were, Dr. Ricketts went through the experience of losing money in a mine and of becoming 'broke'. That was a useful experience, for it gave him a keen appreciation of the part that money plays in the winning of ore, and inoculated him with the basic concept that mining is only digging unless done at a profit. The contact with the Guggenheims at the Pilares mine is interesting. Evidently at that time the Swiss-American captains of industry now so prominent in mining and smelting were timid of engaging in copper mining, in which since they have scored so successfully. At the Pilares, Dr. Ricketts built his first concentrator and first smelter. That was 25 years ago. Many are the mills and smelters that he has designed and constructed since then. Indeed his later life is crowded with achievements of this kind. He has been an extremely busy man. A veteran engineer remarked to us a few days ago: "Ricketts was as hard a worker as Hamilton Smith and worked in just that nervous way, not wasting a minute, day and night—early in the day and late at night". This association of names is appropriate; Hamilton Smith is only a name to the younger generation, but he was the undoubted leader of the mining profession forty years ago. That reminds us that our interlocutor had a copy of 'The Ores of Leadville and their mode of occurrence as illustrated in the Morning and Evening Star mines, by Louis D. Ricketts, B. S., Ward Fellow in Economic Geology of the College of New Jersey, Princeton, 1883'. That was the thesis by which he won his D.Sc. The newness of much of our engineering practice is suggested by the references to the introduction of belt-conveyors in mills and to the use of structural steel; likewise the adoption of gas-producers for generating power. In connection therewith, Dr. Ricketts had a chance to do honor to John Langton, and he availed himself of it gladly, as in his acknowledgments to Thomas Robins, H. A. Fitch, James S. Douglas, H. Kenyon Burch, Charles S. Shelby, Thomas H. O'Brien, Horton Jones, David Cole, W. D. Thornton, John C. Greenway, C. H. Repath, A. G. McGregor, Charles E. Mills, L. R. Wallace, L. O. Howard, James A. Potter, and Henry A. Tobelmann. It is a gallant company, of whose assistance and fellowship any man might be proud. After all, the choice of men is the larger part of generalship, and in this phase of his more important operations in the field Dr. Ricketts has shown a sagacity of no common order. And if a sagacious man works earnestly, he is likely to succeed. All he needs besides is opportunity and health. The latter Dr. Ricketts had in relatively small measure, for he has often taxed his physical strength unduly, but the wiry frame and the nerve of the hardy stock from which he sprang has stood him in good stead. As for opportunities, they were plentiful in the early days of Arizona and in the later days of big copper enterprises. He was ready for them. He had the qualities to make the most of them. One of the qualities was a mind open to new ideas, willing to accept right suggestions, not unwilling to abandon a pet theory if it were disproved or to discard a favorite method if a better were forthcoming. A willingness to give credit to whom it was due stimulated the co-operation of his staff. From them we learn that once he has given a job to a man he lets him alone; he shows confidence by not worrying him; he does not interfere except when it is a part of his duty to do so. Under such conditions, as one of them has told us, there remains "nothing to worry about except the possibility of not proving worthy of that kind of confidence". The record of his varied achievements, covering notable accomplishments in geology, mining, milling, smelting, and other allied branches of engineering, bespeaks a flexible and comprehensive mind, able to make a scientific study of a fresh subject and to apply that study to economic purpose. Another characteristic, essentially scientific, is his refusal to take anything for granted, where doubt exists, in a technical matter. Before he commits himself to a plan of action involving large sums of money, he avails himself of expert advice from the outside. He is not cocksure, but deliberate. That is why he became so successful as a consulting engineer to some of the largest companies operating in the South-West. And with it all he has a sense of humor. William C. Greene, the Colonel of Cananea fame, was persuaded to bore for oil near the copper mines in Sonora, and when he failed to strike oil-sand he asked Dr. Ricketts to advise him where to sink his next well. The answer came promptly: "In Pennsylvania". His friends tell us that—until he was married—he was "not much on clothes". Indeed, there is a story of his having been rebuffed by a Pullman porter, who mistook him for a tramp. Also—until he was married—he was so immersed in his work that he looked upon the wedded state as interfering seriously with more important things. When a chauffeur whom he employed at Cananea disappeared for a few days, he was overheard to say: "I guess he has gotten in some serious trouble. I suspect it's marriage." However that prejudice of the Doctor's was cured in due time, completely. Among other honors that have befallen him we may mention the presidency of the American Institute of Mining Engineers, in 1916, and the award of a gold medal by the Institution of Mining and Metallurgy, in London, for his paper on 'Experiments in reverberatory practice at Cananea, Mexico'. During the last two or three years he has been trying to retire from active work, but his semi-retirement looks a good deal like an average man's busy season. Whenever he does withdraw from the stress of professional work he can do so with a keen realization of much done and supremely well done, of having fulfilled to the hilt the definition of an engineer as one who has learned "the art of directing the great sources of power in Nature for the use and convenience of Man", and, more particularly, of enlisting the hearty co-operation of other men in winning metals for the needs of our material civilization.

Revision of the Mining Law

The Editor:

Sir—It seems to me fairly evident that in revising the mining laws we have the interests of another eternal triangle to consider. This triangle is made up of prospector, capitalist, and engineer, technician, or operator. The interests of these three groups, while identical in many respects, may become divergent when considered on too narrow a basis, as appears to be the case in much of the discussion that has appeared in your columns.

Obviously eminent engineers composed the commission that prepared the draft of the proposed revision. A certain chain of events leads to this position of eminence and may result in a viewpoint widely and innocently divergent from that of the prospector. The more widely an engineer practices successfully, the more eminent he becomes, the less he has to do with prospectors and the more with capital. There is a tendency for his point of view to become progressively that of the large operator, or large company, which may be called the capitalist angle of the triangle. He is in close touch with the losses due to apex litigation, and in reaction against this is prone to allow the pendulum to swing too far in the opposite direction, and in trying to relieve operators of their onerous burden, he may in perfect good faith inadvertently add to the burden of the prospector.

On the other hand, the prospector is rarely concerned with apex suits, and views the revision from his viewpoint only. Discussion so far seems to have come from these two angles. As my present occupation has to do directly with neither prospector nor capitalist, possibly I may be conceded to have a viewpoint that is at neither extreme, and to be able to look at the question judicially in its bearing upon the mining business as a whole. Standing in the centre of the triangle it would appear to me extremely desirable to so modify our mining laws that the difficulties of applying the law of the apex may be eliminated, at least as to future locations, and as to re-locations of claims now held. We are all aware of the vast number of claims that are annually re-located in lieu of assessment work, so it may be granted that, after all, the new law would in course of time apply to a sufficient number of locations to make the reform worth while. While gaining this desirable end let us not add to the burden of the prospector. Vertical boundaries to avoid apex disputes, large square locations to ensure adequate ground in case the vein proves to have a course widely divergent from that assumed at the time of location, elimination of location by cardinal points to obviate the endless difficulties of tracing old lines, often inaccurately run, would, I feel, accomplish the desired end. There would be some overlapping of claims, of course, but this would not be a serious objection, because the overlap would be in one plane only, and not in three, as under the apex law.

The discovery required may well be modified so that a claim may be held for a long enough time without discovery as will ensure diligent effort to find mineral. Surely if mineral sufficient to constitute discovery cannot be found within five years, the locator might with justice be compelled to forfeit his claim. Certainly no money payments after that date should be permitted to tie up claims indefinitely without discovery. By such an absolute limit to possession without discovery, the capitalist would not be favored at the expense of the prospector.

Most assessment work is known to be virtually useless. The law might, perhaps with difficulty, be amended to secure more bona-fide and effective assessment work. By no means should the payment of cash in lieu of assessment work be permitted. Many substantial reasons have been given in previous discussion and need not be repeated here.

Mr. Sheldon's recent comments concerning the need of permanent monuments are pertinent, and any engineer accustomed to examining prospects will be inclined to agree with him.

My excuse for occupying so much space in your valuable columns may be found in a desire to contribute something that should be free from the bias that has been too frequently evident in the recent discussion of the revision of the mining law.

L. O. Howard.

Pullman, Washington, September 12.

The Editor:

Sir—An examination of the text of the proposed new mining law indicates a radical departure from some of the basic principles of the present law. They seem to me to be unwise, both from the standpoint of the miner and of the Government.

The purpose of the law is, or should be, to secure the exploration and development of the mineral areas, and to do this, every encouragement should be given the prospector and miner that is legitimate, with as little hampering red tape as possible; and it should be recognized as well that the prospector is probably as honest as the Government appointees.

The search in the field by the prospector is what leads to the finding of new ore deposits—not sitting in an office,

and drawing checks in favor of the Government in lieu of such work, which method leads to tying up large areas without active development work.

To summarize briefly, I offer a few suggestions:

(1) Annual assessment work of $5 per acre should be required, and performed (and not payment to the Government in lieu of same).

(2) Claims should be allowed to be staked without discovery, providing that in such cases work shall be commenced on such claim, say, within 60 days after location, and a shaft at least 5 ft. by 5 ft. square sunk at least 20 ft., or its equivalent, if done by tunnel, before the expiration of 120 days; this work to count as the assessment work for the first full year, and fraction of year, in which the claim is located.

(3) The affidavit of the locator, with one reputable witness as to discovery, should be sufficient. The prospector should not be compelled to pay the expense of a U. S. Deputy Mineral Surveyor to examine and verify same.

(4) It should not be compulsory to patent claims within seven years. The prospector may not have the means to do this, but, by his own labor, may be able to keep up his assessment work in the nature of development work on his property.

(5) Discovery should be specifically set forth, to be (in the language of one of our most competent judges, who was a miner himself) "such a discovery of mineral as will warrant the expenditure of labor and money in its development by the discoverer".

(6) In case of location of a claim, with an actual discovery, a 10-ft. shaft, 5 ft. by 5 ft., should be sunk (or its equivalent in cut or tunnel), within six months from date of location at said discovery point, to be counted as part of the assessment work.

(7) Locations should conform as near as possible to the lines of Government survey. The prospector in locating cannot be expected to be a surveyor, and until his location is perfected, he may not wish to disclose his discovery to others.

S. A. KNAPP.

San Francisco, September 20.

Copper

The Editor:

Sir—It seems to me that there should be some remedy for the diseased condition of the price of copper besides 'supply and demand'. It is unreasonable that a public necessary, on which depends the prosperity of the West and to a great extent of the nation, should sell at less than the cost of production, especially when that cost has been reduced to a minimum through the application of every possible device for saving material and labor, the use of modern machinery of enormous capacity, operated at a degree of efficiency probably unequaled in any other industry.

Of course, when the copper surplus has been depleted, the price will advance naturally, but in the meantime how many clean and wholesome copper prospects and projects will be reported in the issues of 'The Copper Handbook' as "dead"? Must we sit back and watch the industry suffer? We know that the largest producers are safely entrenched financially and can weather a long hard slump, but at what cost to the public?

Mr. J. L. Harmon, in his letter to you, opens a way for all of us to assist in a small way, in disposing of the accumulated copper. It would appear that the daily press of the country would be sufficiently interested to take the question up, as there is much that can be written that will interest the general public.

At the present price of copper, solid copper utensils of all kinds can be produced at a cost lower than many inferior materials having short life; they could be sold in competition with the inferior articles and if the public was advised of the value of these copper utensils, there would be a demand.

There are many small parts of machinery used in every line of endeavor that can be manufactured of brass. Today these parts can be cast of brass at a lower cost for the finished article than if made of steel—almost as cheap as if made of cast-iron.

When we are given patterns or drawings with a request for estimates on cast-steel parts, if in our opinion the parts will prove as economical if made of bronze or brass and will answer the same purpose, we offer the suggestion or make the recommendation that brass or bronze be used. If all manufacturers of machinery will do this, we believe that it will, at least in a small way, assist in disposing of the copper surplus.

Los Angeles, September 17. M. F. DONAHAE.

Electricity v. Steam in Gold-Dredging

The Editor:

Sir—In criticizing my conclusions regarding the inadequacy of installing electric dredges on the Kolchan mines of the Orsk Goldfields, Ltd., Mr. G. L. Holmes, in his letter published in your issue of April 30, rather sidesteps the question. At the outset I wish to emphasize that nowhere in the course of my article did I argue against the use of electrically-driven dredges, and I had no intention to comment on the relative merits and advantages of steam-dredges as compared with electric ones. As clearly stated, my remark relates to the one particular case mentioned on the Kolchan mines, but as Mr. Holmes seems to advocate the installation of electric dredges in all cases, and under all circumstances without exception, may I be permitted to analyze his arguments.

On all well-designed steam-dredges the entire machinery—boilers, engines winches, etc.—is placed alongside and forward of the main gantry, leaving the whole deck aft of it free for the washing apparatus, just as is the case with electric dredges; and on account of this it is just as easy to place adequate gold-saving appliances on a steam-dredge as on an electric one. On the latter the fore part of the deck is clear, but it is of no use for the saving of the gold. Reduction of space for the gold-saving devices on dredges depends on the disposition of the

machinery, and is not necessarily a consequence of the use of steam as driving power.

Boilers economical in the consumption of fuel may be used on dredges, as, for example, boilers of the locomobile type with superheated steam (system R. Wolff, Buckau-Magdeburg), which may be considered as economical as any stationary boiler in a generating plant. The type of main engine and winches used on dredges may not be quite as economical in the use of steam as the stationary engines of a power-generating plant, but, on the other hand, to convert steam-power into electric current and again transform this latter into mechanical power is not an economical process; and then there is power lost in the line. All these losses have to be compensated by an extra consumption of fuel at the electric-generating plant, and I venture to state that all in all the application of steam direct on the dredge is more economical than by means of an electric-power plant on shore.

The escape of vapor from leaky pipes, to the action of which Mr. Holmes ascribes so prejudicial an effect, cannot be considered a serious factor, especially since wooden hulls are almost entirely abandoned. If there is an escape of steam from leaky pipe-connections it is a proof that the man in charge of the piping has not done his work conscientiously. On the Schouvaloff dredges, on which the whole machinery, the digging apparatus and washing appliances, was enclosed in a housing, and operations were carried on until the beginning of winter, sometimes even until the end of December, when the temperature was from 15° to 20°R. below zero, there has never in the course of ten operating seasons been a noticeable escape of steam from the pipes.

The conveying of wood-fuel on board the dredge is not so arduous a task as Mr. Holmes thinks, being greatly facilitated when piling the wood alongside and close to the lateral boundary lines of the area to be worked in accord with the advance of the dredge. This is an easy thing to do everywhere in Russia, the Kolchan mines included, as the haulage of wood-fuel is always done by sleigh at the beginning of the winter before the heavy snowfall, and therefore does not require the construction of any roads. With an electric-generating plant using wood-fuel supplied from the surrounding forest no permanent haulage-road can be constructed, as Mr. Holmes suggests, because the haulage is constantly changing as the felling of the wood progresses.

The handling and firing of fuel is the same in both cases, with electric as well as with steam-dredges, as it requires the same amount of labor (one man per shift) to haul the fuel from the stacks to the boiler-house as from the banks of the pond to the dredge. Thus, when using wood-fuel, a steam-dredge and an electric one are exactly under the same conditions as far as haulage and firing are concerned. As for the dirt, I think it is easier to sweep it overboard than to shovel it and carry it away from the boiler-house. There is one feature decidedly in favor of the steam-dredge that is of special importance in cold climates, consequently for the whole of Russia and Siberia, and that is the heating, which on a steam-dredge is gratis, whereas on an electric dredge special boilers or stoves have to be installed, and above the extra expense the task of conveying fuel on board the dredge cannot be avoided, at least during part of the operating season.

Mr. Holmes says, "the life of the electric dredge (accidents excepted) will be 50% longer than that of a steam-dredge, that it will handle a minimum of 33⅓% more material than the steam-dredge, will be 100% more economically efficient". On what calculations are these statements based? They appear unfounded. The life of a dredge depends mainly, if not exclusively, on the strain to which the digging apparatus is subjected, and this is in direct relation to the nature of the ground worked quite independently of the mode of generating power for breaking up the ground. It is beyond contradiction that the same dredge dealing with loose sand, or working in easy ground, will have a much longer life than working in hard ground, such as cemented gravel containing large boulders, or breaking up tough and hard bedrock. Given two dredges of equal bucket-capacity, working the same ground under otherwise the same conditions, the yardage will depend on the power driving the bucket-line, that is, on the number of horse-powers applied to the shaft of the upper tumbler. Whether these horse-powers applied are developed by steam or by electricity makes no difference, especially when the usual mode of transmission of power by belting is used in both cases. Therefore, from a technical point of view, I see no plausible reason why an electric dredge should handle more material than an equally powerful steam-dredge of the same size working in other respects under identical conditions. Why just a minimum of 33⅓% in favor of electricity, and not 20 or 50%? What is the criterion? As far as economic efficiency is concerned it is a matter of consideration in each individual case, except, naturally, in those comparatively few instances where electricity can be generated by cheap water-power.

The case of the Conrey Placer Mining Co.'s dredges is not persuasive. Was it solely the substitution of one driving power for the other that converted a losing enterprise into a profitable one? If so, it only shows that in this particular instance, on account of local conditions, the generating of electric power by steam proved cheaper than the direct use of steam, but, I believe, there is far better reason to ascribe the favorable results to the fact that the ground had been worked before, and thus formed a loose disintegrated material, so that a considerably greater yardage and better saving of the gold were obtained. It is a fact known to every gold miner that ground re-worked even by the original method nearly always yields some profit, and it appears to me beyond doubt that if the Ruby placers had been re-worked even by the same old steam-dredges, some profit would have been made, if not so large as obtained by the installation of modern improved dredges. The main factor of success was that the new electric dredges were of modern construction, and certainly all the experience gained during

the operation of the old steam-dredges was taken advantage of in designing the new ones, first of all in regard to the gold-saving appliances. Mr. Holmes does not state if the new electric dredges had buckets of greater capacity than the old ones, but this is likely to be the case, because in the early period of dredging, before 1906, buckets of 7.5 or 9.5 cu. ft. capacity were not in use in close-connected bucket-lines, as far as I know. All this goes to show that the performance of the old steam-dredges and that of the modern electric ones, which replaced the former, is not comparable from an economical point of view. I venture to say that if the old steam-dredges had been replaced by modern steam ones, better built and better designed with adequate gold-saving tables, which, as said, can be placed in a perfectly satisfactory manner on steam-driven dredges, the result would have been much the same as with the electric dredges.

At present there are three kinds of driving machinery on dredges: electric, steam, and oil engines. The last type has been hitherto used for operating small dredges only, but if authorities in naval construction are thinking of supplanting steam by oil on dreadnoughts it is almost certain that in the near future this engine will be applied to large dredges also. Each of these three types of driving machinery has its own field and will prove the best suitable in certain individual cases according to the set of conditions under which the particular dredge has to operate. I am aware of the advantages of the electric dredge, but these advantages do not, under all circumstances, outweigh the positive features of the steam-dredge. I fully believe that electricity on the Conrey dredges was the most suitable driving power to use, the more so that the electric installation supplies four dredges, but Mr. Holmes' statements do not alter my opinion that the use of electricity for driving one dredge only* on the Kolchan mines, or the placing of the generating plant 15 miles away when there is plenty of the same kind of fuel close to the working area, is an exaggeration in engineering, from the economical as well as from a technical point of view, which cannot find its justification in any plausible reason.

L. A. Perret.

Yokohama, July 21.

Education of Engineers

The Editor:

Sir—I have just noticed some excellent remarks on the above subject in a letter by Mr. Augustus Locke, which appeared in the issue of April 16. Among other things, Mr. Locke stated that, "A few simply stated precepts—such as that of William James: 'Seize the very first opportunity to act on any resolution you make . . .'—learned thoroughly and incorporated in the character by practice, might be more valuable than an average university education. It is conceivable that we will some time have important schools that will undertake to teach nothing else". Let us hope that this may be so, for they would certainly teach something that need never be forgotten—something that would be of inestimable value throughout life.

The advice of William James, stated in simpler language, is, 'Do it now'; and no more valid reason for success in life was ever advanced than a profession of adherence to this simple rule. The unprogressive nations of the world are those which, as aggregations and as individuals, never do today what can possibly be put off until tomorrow; among the private individuals in any nation the failures are always to be found among those who procrastinate. It is not an easy matter to act up to the simple advice contained in so hackneyed a phrase; yet I believe with Mr. Locke that if we learned to respect the vital importance of prompt action, as soon as a good resolution was made and when our duty was clear; if we realized the cumulative ill-effects of unpunctuality, postponement, and delay, we could dispense with much of the useless facts and figures with which we clutter our heads when in school and college. Instead we would be in a position to discriminate between the worth-while and the valueless, between the trivial and the important, between the productive and the useless; and we could do this at a time when our training had taught us to 'do it now'.

More can be achieved by the exercise of an acquisitiveness for the information that we know is valuable, than otherwise would result by the reception of the miscellaneous facts, figures, and other data, the memorizing of which constitutes the modern idea of education. The failure of so many machine-made graduates is due to the entire absence of facility in the exercise of good mental habits, when the big problems of life have to be tackled. It would be interesting to learn how many successful men owe their present position, not to what they learned at college or at school, but to the recognition of the importance of fundamental principles of discernment between what is true and what is false, coupled with an encouraged acquisitiveness for what is valuable and useful.

J. W. T.

San Francisco, September 7.

*According to latest information given in Mr. Speak's letter published in 'M. & S. P.' of June 18, 1921.

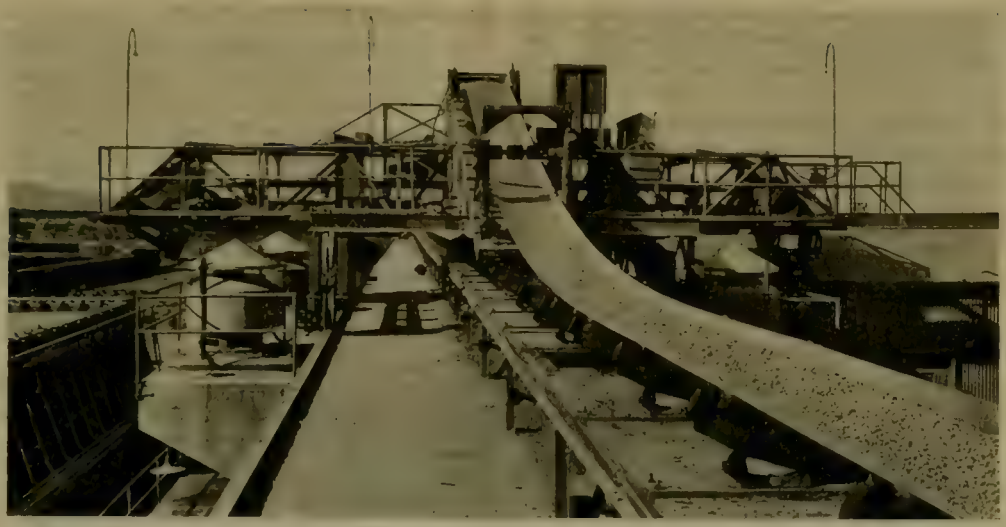
Flotation and Lubrication

The Editor:

Sir—Some time ago an old sailer told me that the bottom of a racing yacht was first painted, then tallowed in order to make it slip faster through the water. Wouldn't oiling the bottom of a vessel have the same effect as tallowing the bottom of a yacht? The oil could be forced through small holes in the bottom. But how make the oil stick to the sides? Here, it seems to me, is where the flotation engineer might apply his science. It strikes me there are great possibilities in the way of saving time and fuel by lubricating the sides of a vessel with oil.

Wm. Crocker.

Prescott, Arizona, September 17.



ORE-CONVEYOR IN THE NEW CORNELIA MILL

Louis Davidson Ricketts, of Arizona

An Interview. By T. A. Rickard

Dr. Ricketts, you are a New Englander by birth?

No; I am a Marylander. I was born at Elkton, in Cecil county, Maryland, in December 1859.

Were your people interested in mining in any way?

My father was the owner and editor of a country newspaper, and his family had been farmers in Cecil county since the 17th century. My mother was the daughter of a Scotch-Irish school-teacher, from the University of Belfast; he came over to this country with his wife and conducted a private school. My father died a few months after I was born. My mother had four children and made up her mind she was going to educate them. She was in the South, the war came on, and she had to wait five years to settle up my father's estate. Then she moved up to Princeton and gave all of her children a higher education, for the time being at great personal sacrifice.

You went through the public schools and then to Princeton?

No; I had a defect of the eyes when I was born and did not learn to read until I was ten, so I received my preliminary education in private schools. You know our public-school system was not much to boast of in those days. I entered the John C. Green School of Science, in the College of New Jersey, now known as Princeton University.

When did you graduate?

I graduated in 1881, was awarded a fellowship in chemistry, and spent the following year in post-graduate study.

In chemistry?

Yes, in chemistry. About that time, Dr. McCosh, president of Princeton, had made a tour of the West and met a Princeton man named W. S. Ward, of Leadville. Ward offered a competitive fellowship in economic geology open to post-graduates. I was awarded this fellowship and went out to Leadville, in accordance with the terms of the fellowship, to study mining geology.

At that time Leadville was booming, was it not?

Leadville was in its glory, although there were really no very large individual mines, as measured by later standards; it consisted of a number of large ore deposits chopped up into small holdings. After I had completed my studies at Leadville, which lasted four or five months, I returned to Princeton in the fall of 1882, wrote my thesis on the ores of Leadville, for a doctorate, and was granted a degree of D.Sc., 'in course', at Princeton.

What does "in course" mean?

It means that you take the degree as a result of examination after two years of post-graduate study; it is not an honorary degree.

How did you pass from chemistry to mining?

While I was trained as a chemist, I had had a little experience in surveying. At the end of my post-graduate course, I was offered the choice between teaching at Princeton and going to work as a surveyor for the Morning and Evening Star mines, which were under the management of Mr. Ward, and I remember particularly the advice that was given to me by my dear friend, Professor Henry B. Cornwall of Princeton. He told

me that, although he would be glad to have me as his assistant, he knew that there were great mountain systems in the West, that Gilpin county had been developed, and that now Leadville had come, and that he thought there surely would be a great development of mines in the mountains of the West, and he believed that, if he were I, he would take the chances and go out and grow up with the West.

He must have been a man of some imagination?

I should hardly say that; he had wonderful common sense.

When did you go to Leadville as surveyor?

I went there in July 1883, and remained as surveyor of the Morning and Evening Star mines until the spring of 1885. At that time I was given the opportunity to go to Silverton, to take charge of the development of some mining claims on Galena mountain and in Poughkeepsie gulch. They were owned by the Gipsy Maid Mining Co. of New York City. Slight development showed that these prospects were valueless, so, in the fall of 1886, I recommended that they be closed-down, and was out of a job.

I remember meeting you at the Morning Star mine at Leadville in the fall of '86, so I presume you returned to Leadville.

Yes, I returned to Leadville and entered into general practice as a surveyor and remained there until the spring of 1887, when I was offered the position of Geologist of Wyoming, which I accepted.

How did it happen that you were offered this appointment?

Wyoming was then a Territory, and President Cleveland had appointed Thomas Moonlight, of Kansas, as Governor. The position of Geologist of the Territory was vacant, and he, not being a mining man, requested the Governor of Colorado to recommend a man.

Was Alva Adams the Governor of Colorado at that time?

Yes; Governor Adams referred the matter to Fred Buckley, of Leadville, who recommended me for the position.

You liked your work in Wyoming?

Yes, I liked it very much. I was inexperienced and was really not much of a geologist, but I liked mining and kindred subjects, and I not only worked officially and published various reports, but I was also encouraged to, and did, take outside consulting work within Wyoming, and during my time there had experience in railroad reconnaissance work for the Union Pacific and Burlington railroads.

How long did you remain there?

In 1889, I think it was, Wyoming became a State, and Francis E. Warren was elected governor. He is now U. S. Senator. He re-appointed me as Geologist, and I remained until the fall of 1890, when I resigned to take a position in the South-West with Dr. James Douglas.

How did you first meet Douglas?

In the summer of 1881 I joined a college friend in surveying his father's country place on the Hudson river. Eight years afterward, my friend and his father recommended me to William E. Dodge as a capable young man, and Mr. Dodge spoke of me to Dr. Douglas, who sent for me and, after taking me on a trip to Arizona, employed me as an examining engineer. That was in the fall of 1890. I spent some time in studying the coalfields of northern Sonora and those on the Apache Indian reservation in Gila county, Arizona. These coalfields were worthless, but Dr. Douglas was very anxious to find coal and sent me back repeatedly to examine them. I remember that he told me that the transmission of electric power was going to become vastly important, and that if I could find even an inferior grade of coal that would burn at the pit he believed that we should acquire it, because, with the development of electric transmission, it would be of great service to the Arizona mines, on account of the great distance that coal had to be hauled to the South-West. At that time Dr. Douglas had purchased the Copper Basin mines, near Prescott, and was installing a small leaching-plant to test the Hunt and Douglas process. For about a year I was in charge of this enterprise. The process was sound theoretically, but metallurgically it was a failure, owing to the mechanical imperfections of the plant and the volatilization losses. Apparently, oxy-chlorides were formed in large quantities, which could not be removed by washing, and caused great loss by volatilization when the impure sub-oxide of copper was smelted.

What did you do next?

About the close of 1892 I left Dr. Douglas and worked on my own behalf in Colorado and Wyoming as a consulting engineer. I also mined on my own account in the Silverton district, making trips to the South-West for Dr. Douglas at intervals. At Silverton I obtained the most valuable experience of my life. I took a lease, jointly with friends, on the Sierra Madre mine on Galena mountain. We struck a pocket of 10-oz. gold ore and made a little money. This gave us courage to put up a mill before the mine was sufficiently developed. The result was that in 1895 I 'went broke' and had to borrow money to pay my debts. What seemed then a disaster proved to be a blessing, because it taught me two things: first, that it is necessary to develop a property before capital expenditures are made for a plant; second, that it is unwise to try to operate a low-grade mine without sufficient capital.

So the rich pocket happened to be—

It proved to be superficial, and the larger bodies of lower-grade ore that we relied upon were likewise superficial.

You will agree with me, Dr. Ricketts, probably, that a little experience in leasing is an excellent experience for a young engineer, by teaching him the fact that the purpose of mining is to make money; in other

words, it brings him face to face with the economics of the industry.

Yes. In those days, I think, it was advisable that a young man should either lease or otherwise go into mining on his own account, in order to gain a concrete idea of the responsibility of mining, and the same thing, I think, holds good today, except that there are not as many opportunities for leasing and mining in a small way.

Then would you expect a graduate from a mining-school to go to work underground? As you know, there has always been a question as to whether educated young men should begin their careers by doing manual work.

THE SMELTER OF THE CANANEA CONSOLIDATED COPPER COMPANY, IN SONORA, MEXICO

I think that depends very much upon the individual. Manual work gives him an opportunity to know the viewpoint of the workman; and, if in the future he is called upon to handle men, such an experience is immensely valuable to him. This is merely an opinion, because I have not worked either as a miner or a smelter-

THE CANANEA CONCENTRATOR

hand; but I have always regretted that I did not have a little experience of the kind, in order that I might be closer to the worker's viewpoint.

You were saying that your mining near Silverton left you 'broke'. How did you extricate yourself?

Dr. Douglas employed me as his assistant. I went to work for him in the previous winter of 1895. That winter I took a pack-train and made an extensive investigation of the resources of northern Sonora. Among other places, I went to Nacozari. At that time the Guggenheims had bonded the Fortuna and Pilares mines, and were doing development work. They were operating a small silver-mill that had nothing but a crusher, rolls, and jigs, and they were packing concentrating ore from the Pilares six miles down the mountain, treating it at this mill, and roasting the concentrate in a Pearce turret-roaster, using oak as fuel. The calcine was then briquetted and smelted to a matte in a 36-in. water-jacketed furnace. The smelter was running intermittently, of course; the ore that they were mining contained about 6% copper; and the smelter was 90 miles from a railway, so I assumed that the work was being done in order to obtain information for a proper metallurgical plant. It transpired, I believe, that the owners expected to profit from the operation, and when they met with a decided loss they became discouraged. I was tremendously impressed with the Pilares mine and thought it a great property, so, when later the Guggenheims represented to Dr. Douglas that they were not copper miners and offered to turn the property over to him if he would assume the bonded debt, which was small, and pay them a very reasonable compensation in case he developed the property successfully, I advised him to make the deal. Dr. Douglas himself visited the property in the fall of 1896 and purchased it for himself and his associates of Phelps, Dodge & Company.

So you became the godfather of Nacozari?

Yes. I succeeded Mr. Danforth as general manager, developed the mine, designed and built a concentrator and smelter. At the same time I designed and built a 400-ton concentrator, a large mill in those days, for the Detroit Copper Mining Co., the financial interest in which was purchased by Phelps, Dodge & Company in 1897. In designing this mill I met Thomas Robins, who had but recently formed the Robins Belt Conveying Co., and as a result I installed one of his 36-in. and two of his 18-in. belt-conveyors at Morenci. This installation, as far as I know, was the first of its kind in the Rocky Mountain region. At this time, in 1897 or '98, I forget which, I made a trip through the North-West to study milling practice. At Salt Lake City I met L. S. Gillette, who founded the Minneapolis Structural Steel Co., and he convinced me of the superiority of steel over wood construction for mills and smelters. As a result of this conference, I introduced all-steel construction in the South-West. Since that date I have directed work consuming many tens of thousands of tons of structural steel. H. A. Fitch, a young designing engineer and salesman in the employ of Gillette, began to come to the South-West a few years afterward. He aided me greatly in designing and made many valuable suggestions. We became warm friends and later in 1906 we became associated in the srtuctural-steel business, which he wished to enter. While I knew nothing of the business, I knew the man. He has become highly successful after a long and hard pull.

In the construction of the Nacozari plant, my old friend, John Langton, designed the transmission machinery and the power-plant, and supervised its construction. This plant was novel in that it consisted of seven 250-hp. Crossley gas-engines, belted to d.-c. generators, the motive power for the smelter and concentrator machinery being furnished from this central plant. Mr. Langton installed a gas-producing plant of two Loomis-Pettibone producers. At that time Nacozari was 90 miles from a railroad, and as there was abundant oak in the vicinity, Mr. Langton was of the opinion that he could generate a producer-gas from wood, which was done successfully for several years.

Langton died recently, did he not?

Yes, Langton died of pneumonia, in February 1920, at Inspiration. He was a man of splendid personality. He had a tremendous fund of general information, was a good critic of books and plays, and had a profound knowledge of the theory of his profession, and as a consulting mechanical engineer, especially on power and the transmission of power, he did splendid and valuable work. As a mechanical engineer he was identified with the development of the great copper industry of the South-West.

Returning to Nacozari, did you remain there long?

As the Nacozari mines developed, it became evident that a railroad was abundantly justified, and the railroad was completed, though not as soon as I advocated. After the plant had been completed and the success of the mine demonstrated, I was transferred by Dr. Douglas to other work, and was succeeded by his son, James S. Douglas, who managed the property for a number of years very successfully. When the railroad was completed to Nacozari, the steam-turbine had been sufficiently developed, and coal was then obtainable as fuel, whereupon Langton designed a turbine-plant replacing the Crossley engines, which had become antiquated. This was one of the first turbine-plants in the West, I think. At the same time H. Kenyon Burch designed a much larger concentrator to meet the requirements of the mine; this was constructed under the supervision of Mr. Douglas. In the meantime, a reduction works had been built by the Copper Queen company at Douglas, the Nacozari smelter was abandoned, and the concentrate shipped to Douglas for treatment. The Nacozari property continues to be a great producer and has proved enormously valuable.

What was your next task after you left Nacozari?

I took a rest and went to Europe. On my return I was sent to Globe. In 1890 and succeeding years, Dr. Douglas had acquired the Old Buffalo mine, the Hoosier property, and other claims at Globe, which were brought together

under the name of the United Globe Mines. The development work on these claims, for the time being, was dis-

THE INSPIRATION MINE

appointing, and for several years the work there was more or less quiescent. In the meantime, the Old Dominion

THE INSPIRATION MILL AND THE INTERNATIONAL SMELTER, AT MIAMI, ARIZONA

mine had been acquired by the Lewisohn-Bigelow interests, and after a somewhat varied career the control was taken over by a group of stockholders under the leader-

ship of Charles S. Smith. The possibilities of this great mine had not been recognized. It had been worked exclusively for high-grade ore; the low-grade material had not received attention, nor had the mine, which had developed large quantities of water, been equipped with the proper machinery. As a consequence, the company was nearly bankrupt. In 1903 a consolidation was effected

between the Old Dominion and the United Globe mines, through which the then Phelps Dodge interests assumed control. I was put in charge as manager, and completed the construction work that had already been started by the Old Dominion company under the supervision of Frederic W. Hoar. During the three years following my assumption of the management, I designed and built a concentrator and completed the smelter, but the main task was to re-open the mine. For years the workings had followed the main fault-fractures along which the ore deposits occurred; here the ground was soft and the openings could not be maintained; the foot-wall of the ore deposit, however, which was of diorite, was firm and solid, and an entire new set of workings had to be opened up in the foot-wall country on the six active levels in order to eliminate prohibitive maintenance costs and to avoid ruinous delays. The ore-bearing ground was attacked through numerous short cross-cuts.

Did you have any metallurgical problem?

Yes, several important problems. When I assumed control of the Old Dominion a young man who had worked at Aguas Calientes for the Guggenheims was the metallurgist; and this was my first meeting with Charles S. Shelby. In the years that followed I was associated with him intimately. Shelby was somewhat of a dreamer, but had a wonderfully suggestive mind, and was, I believe, one of our metallurgical geniuses. As often happens, his mind was so active in suggestion that it was difficult for him to separate the commercially feasible plans from the impracticable ones. Shelby left me finally to go to Cerro de Pasco. He did, I am told, invaluable work for that company; and, I believe, by his unfortunate death in an automobile accident, the metallurgical profession was deprived of one of its most valuable members.

During the years that you were at Globe was your attention ever called to the low-grade deposits on which the success of the Miami and Inspiration companies is founded?

No: I knew of the claims, but I had no comprehension of their latent possibilities at that time.

Did you make any changes at the smelter?

After the concentrator was completed, it became evident to me that the blast-furnaces at the Old Dominion ought to be supplemented by a reverberatory plant, because the fine concentrate tended to blow out of the blast-furnace about as fast as it was put in, and the mechanical loss of copper was excessive. At first Dr. Douglas was unwilling to authorize me to proceed with this heavy expenditure; however, he gave his consent finally, but about that time I left the employ of Phelps, Dodge & Company, and the furnace was never built. It is interesting to speculate on what the result might have been had a reverberatory plant been erected by the Old Dominion company, for the reason that in that event undoubtedly it would have contracted to smelt the Miami concentrates and thus would have gained knowledge of latent possibilities that would have been invaluable. Such a development in metallurgical practice would have revealed the potentialities of the Miami district outside the Miami Copper Co.'s property.

You are referring now to a period before the Inspiration Consolidated Copper Co. was organized; do you refer to the group of small mines such as the Black Warrior, Keystone, and Live Oak?

I am referring to the groups of claims that have since become the property of the Inspiration Consolidated Copper Company.

You had a lot of water in the Old Dominion?

We had a lot of water. Previous to my coming they had purchased a number of large Prescott direct-acting steam-pumps. These pumps were flagrantly extravagant in the use of steam, and proved a source of great expense. In spite of the fact that the company had just purchased these pumps, I made up my mind that, with the great quantities of water to be handled, a higher-class pump should be used; accordingly I arranged to put in high-pressure boilers, and purchased four triple-expansion duplex crank-and-flywheel pumping-engines, each of 1000 gallons capacity, from the Nordberg Manufacturing Co. These pumps were delivered, but not installed, during my regime as manager of the Old Dominion. I understand that when they were installed some years later they reduced the pumping expense about $10,000 per month.

How much water were you pumping?

The amount of water varied, but at that time it averaged about 3½ million gallons per day from a depth of about 800 feet.

What fuel did you use?

Oil. That reminds me; it was during this period that Dr. Douglas purchased the El Paso & Northeastern Railway in behalf of the Phelps Dodge interests. At the same time the same interests purchased the Dawson Fuel Co. The coal-washer at Dawson, New Mexico, was inefficient, and it was evident that the slack or crushed run-of-mine coal had to be washed in order to produce a superior grade of coal for coking. At this time I went to Europe to study the progress that was being made in England and Germany in washing coking coal, and on my return in 1905 I designed a coal-washing plant in conjunction with Thomas H. O'Brien, who afterward became manager for the Dawson Fuel Co. and is now general manager for the Inspiration Consolidated Copper Co. This washing plant was a new departure in the coal-mining industry, and I think that most of the good people of Colorado and New Mexico thought that I was mildly insane in building it, because I introduced steel construction and reinforced concrete work, building a substantial plant, instead of the usual ramshackle wooden affair that requires excessive repairs and a maximum labor cost. Although the plant became antiquated in time, it was very successful; it did clean work at a minimum cost, and produced good coke.

Do you remember any figures of cost?

No; it is too far back. All I remember is the costs were

as estimated, the coal was cleaner, and the saving of coal was greatly increased. For the construction of this plant I recommended Horton Jones to Mr. O'Brien as construction engineer. He was a genius at this kind of work. Later he did splendid work for me in the construction of the Arizona Copper Co.'s smelter, and is now assistant manager, I believe, for the International Nickel Co. at Sudbury.

It is interesting to note how men like Messrs. O'Brien and Jones have been able to apply their knowledge of engineering and of human nature with equal success in the production of one mineral as of another, although usually a colliery experience is not supposed to be applicable to metal mining.

I think that is a mistaken idea. The different classes of mining and metallurgy, after all, are parts of one great art. Most of the advances made in any branch of mining or metallurgical industry are linked to the treatment of products in other branches. For instance, the only difference between washing coal and concentrating ore by gravity was that, in the one case, you saved the heavy material and threw away the light; in the other, the reverse; but the principles of gravity concentration applied to both, and there is every reason to believe that the engineer with extended experience in ore-dressing can bring good ideas into coal-dressing. The same reasoning applies generally to handling and transporting materials.

Obviously, your association with Douglas was one of the most important features of your career.

Yes, indeed. It gave me a wide variety of experience. My close association with him was undoubtedly of personal benefit. The point of Dr. Douglas's character that stands out in my mind was his imagination. He had great insight, and in conjunction with William E. Dodge and D. Willis James, who had the shrewdest financial sense, he built up a great and wonderful enterprise. I want to lay emphasis on his remarkable sagacity in foreseeing the latent possibilities and resources of the South-West, and upon his untiring efforts to improve metallurgical processes.

When did you begin your connection with Cananea?

While I was at Globe I acted as consulting engineer for the Greene Consolidated Copper Co. in so far as their concentrating operations were concerned. I had supervision of the remodeling of their first concentrator and the building of a new one, and in that connection I employed David Cole, who at the time was the superintendent of a small mill at Aspen, Colorado. I found Mr. Cole a very competent young man, and, as is usually the case when a man comes from one branch of industry to another, he introduced new ideas effectively.

THE ARIZONA COPPER COMPANY'S SMELTER AT CLIFTON, ARIZONA

Did you then assume the management of the Greene Consolidated?

No; I did not. I was offered the management of the Greene Consolidated, but at that time was not satisfied that it could be properly financed, and thought it better not to accept. During this time and previous to this time I had become acquainted with William C. Greene. I admired the many good points in his character. He was always loyal and generous to his friends, and responsive to any sentimental tie or call from them. I owe to him my first opportunity to make any considerable sum of

money, as he let me have 5000 shares of stock in the America Mining Co., at Cananea. Subsequently I disposed of sufficient of this stock to pay its cost to me and invested the balance in the Greene-Cananea Copper Co. At the end of 1906 the Greene-Cananea Copper Co. was formed and control of its direction was assumed by the present board of directors. I was offered, and accepted, the position of general manager and took active charge in March 1907.

You speak of the present control. Does that mean the Anaconda company?

No, but Anaconda and Greene-Cananea have many common shareholders and the same executive direction.

So you then formed a new and very important professional connection?

Yes, I formed a very important professional connection at that time and also became associated with some splendid men. My direct superior in New York was W. D. Thornton, who since that date has been my constant friend and advisor, and we have worked together in a most harmonious way. Also when I went to Cananea I found a splendid set of men on the general staff. My old friend, James H. Kirk, was superintendent at the mines, and Charles S. Shelby had charge of the smelter, David Cole had the concentrator, Tindall Evans the traffic and purchasing department, and George Young was the secretary of the company. All these able men needed was encouragement and help, and after a general plan of work had been laid out for them, to be shown how to work together. I made no changes in the general staff, except that I reduced it somewhat, and all, except Shelby, continued with me during the major portion of the time I was in active management of the property.

Were there any special technical problems that you had to solve during this period?

Yes. The mines were under-developed and required a great deal of planning and a great deal of money spent in order to centralize, provide new outlets, and open up further ore-reserves. The smelter was an impossible structure and, aside from the bedding plant, had to be completely re-constructed. Steps had to be taken to induce the railways to give Cananea at least approximately the rates that neighboring points in Arizona were enjoying. It was just after I took charge of this property that the panic of 1907 came, and in order to be successful it was apparent that the operating costs at Cananea had to be reduced about 9 cents per pound of copper. This was done but it took all of the planning and hard work of the entire organization to accomplish it.

What was your next professional connection?

While I was at Cananea I was consulted on various matters by the Anaconda interests. I also undertook to act for three years as consulting engineer to the Arizona Copper Co. During that time I built its new reduction works at Clifton. I also became consulting engineer for the Calumet & Arizona Mining Co. at Bisbee. It happened that the old Calumet & Arizona Mining Co. and the Superior & Pittsburg Copper Co., which were affiliated in ownership, wished to consolidate, or, rather, the latter company wished to go out of business and sell its physical properties to the Calumet & Arizona Mining Co. for stock in that company. James S. Douglas and I were employed to recommend a proper basis for consolidation. Following this work, I was employed as consulting engineer by this company, and in association with John C. Greenway, its general manager, built the new smelting works at Douglas in 1911 and 1912. In connection with the construction of these smelters, we necessarily had to have assistants, so we employed C. H. Repath and A. G. McGregor, who designed the Calumet & Arizona smelter under our direction. Later Mr. Repath retired from the firm, but Mr. McGregor became associated with me in the design of the Arizona Copper Co.'s smelter and the smelting works of the International Smelting Co. at Miami. He has developed into a mechanical engineer of the first rank. Since that time Mr. McGregor has gone into practice on his own account, and has recently designed the United Verde Extension smelter and the new smelter of the Cerro de Pasco Mining Co. in Peru, with which operations I have had no connection.

In designing these smelters did you introduce any new features?

No, I cannot say that I originated any really new features in the new smelters in Arizona except that progress was made and careful observation was given to work that was being done elsewhere, and an attempt was made to employ, as far as possible, the best standard practice. As a matter of fact it is rather dangerous to introduce new features in new plants; new features should usually be introduced in established works. I did select new ideas and decide on processes. Gmahling and Shelby had developed the idea of fettling through ports in the roof of a reverberatory, and this idea was carried forward. In the meantime David H. Browne, at Sudbury, had developed the idea of side-feeding the charge and doing away with fettling by protecting the walls of the furnace with the charge itself. These ideas were adopted and developed, and since hand-fettling was no longer necessary and it was therefore practicable to widen the furnaces, I decided it was safe to use larger units, and so I made the first departure in the Arizona Copper Co.'s plant by increasing the width of the reverberatory furnace beyond the old maximum of 19 ft. The latest furnace that I have erected at the International plant is 25 feet wide.

While at Cananea did you smelt any custom ore?

Yes; I had become convinced that, with the exceptionally rich concentrate Miami was able to produce, a high saving could be made, and that the treatment of the concentrate would lead to the building of a smelter at Miami, basing my faith on the belief that great mechanical losses could be avoided by proper construction and by the adoption of Dr. Cottrell's invention, which was then attracting attention.

How did you treat the Miami concentrate at Cananea?

I had to use a temporary expedient. Part of it was

treated in the reverberatory furnace, but a large proportion was dried and blown with the blast through the tuyeres of the converter. In this connection, I built good hoods and an ample dust-chamber for the converters, in order to avoid mechanical loss. Of course, concentrates could only be blown in while the converter was turned up. Later, a contract was made with the old Inspiration company for the treatment of its concentrate, which positively assured the building of a new smelter at Miami. This was done in 1910 or 1911. In this year my principals purchased the Live Oak property and later on it was consolidated with the Inspiration as the Inspiration Consolidated Copper Company.

By your "principals" you mean, I presume, what is usually called the Anaconda interests? Also I would ask whether W. B. Thompson was not in control of the old Inspiration company?

Yes; W. B. Thompson was in control of the old Inspiration company and remained nominally as president of the Inspiration Consolidated for a time. The management was put under my direction by Thornton. The important question then arose of selecting a general manager; I chose Charles E. Mills for this position, because I considered him the best man in America to undertake the development of a low-grade copper mine and the construction of great works in conjunction therewith. The development of the Inspiration Consolidated was an exceedingly interesting problem and required great faith on the part of the directors and the shareholders. The engineers had faith and believed that they could make the property a very valuable one, but the board of directors had to provide about $13,000,000 of gold coin to justify this opinion and wait until after this vast sum was spent before they obtained the concrete results. In this connection, I think that attention should be brought to the necessity of new enterprises involving risk being assured a high return in case they are successful; for the reason that, if expansion is desired, then encouragement has to be given to the expenditure of money, based on the opinion of competent engineers, whose opinion cannot be confirmed until after the money is spent.

What were your metallurgical plans?

Our original intention was to build a wet-concentration plant. Mr. Mills employed H. Kenyon Burch as engineer for the designing of a new concentrator; a mill of 10,000 tons capacity was designed, and the steel structure actually erected. During the erection of this building the Minerals Separation people brought to our attention certain tests that they had made on Inspiration ore.

These tests were made by E. H. Nutter at San Francisco?

THE NEW CORNELIA COMPANY'S PLANT AT AJO, ARIZONA

I believe they were. It was decided, therefore, in spite of heavy interest charges, to delay construction, and arrangements were made for the Minerals Separation company to furnish us with a 50-ton testing-plant, and we conducted experiments with this plant for some months.

Jointly with them?

With their assistance and advice, Yes. The saving was so high and results generally were so encouraging that Mr. Mills then erected a 500-ton testing-plant and tried the froth-agitation process on a scale that he estimated at the time as being equal to the capacity of a single unit in his new mill. At the same time he conducted tests on grinding-machinery and pneumatic-flotation machines. Dr. Rudolf Gahl was employed by him in these investigations, and developed a flotation-cell that is now in use in all but two sections of the new mill. The tests were so thoroughly successful that froth-flotation was adopted. Another important feature was the adoption of a steel-ball mill for fine grinding. I believe this was really one of the large departures in milling. The consequence of

the adoption of flotation and the use of the Marcy ball-mill, which requires very little floor-space, was that our mill, in a building originally designed for a 10,000-ton plant, was able to treat 18,000 tons per day.

Do you believe that the Minerals Separation people are entitled to the royalties they demand?

I don't care to enter into a controversy with which I am in no way connected. I will say that I believe that the Minerals Separation people brought their process to our attention and that, whether their patents are valid or not, they rendered to us at least a great professional service, and I believe that the arrangements that we have with them are equitable and reasonable under the conditions and they certainly bring to both sides peace of mind.

Of course, you have a contract far more favorable than is granted to most mining companies?

As to that, I have nothing to say. In conjunction with the development of the mine and concentrator at the Inspiration, the International Smelting Co. had to build a smelter in which to treat the Miami and Inspiration concentrates. This plant as already stated was designed by McGregor under my direction. L. R. Wallace was superintendent of construction and operated it for several years most successfully. Wallace was the superintendent of the smelting works of the Detroit Copper Co. for many years before he undertook this work. He is an able manager and a metallurgist of the first rank. I sent him from this plant to Chile as general manager for the Andes Copper Co.; and this position he holds still. On account of the fineness of the flotation product it was imperative to avoid mechanical losses as far as possible. For this reason I purchased from the Western Precipitation Co. the right to use the Cottrell process at this plant, in so far as the saving of solid particles was concerned. Exceedingly strong and massive calcining-furnaces were built on account of the tenacity of the wet concentrate, and special methods were adopted for the avoidance of dust in handling calcine from the hoppers and to the furnaces. These have since been improved by L. O. Howard, the superintendent, so that remarkably little loss is sustained in the operation of charging the furnaces, and the calcine-house and the reverberatory feed-floor are as clean as any portion of the smelter.

The treatment of flotation concentrates has given a good deal of trouble to smelter-men, who probably did not at first realize the true character of the product. I would like to ask you whether you would advise the use of some drying-machine between the filter and the reverberatory furnace?

No; as a rule there is some table-concentrate produced in a flotation mill; this helps by admixture to make the flotation concentrate more porous, and reduces the average moisture. I believe that, if sufficient care is taken, the concentrate should not be sloppy, and, of course, it is always advisable in a metallurgical process 'to take one bite at the cherry' if one can.

In other words, avoid a multiplicity of operations?

Yes. The Cottrell process was applied, of course, to the calcining-furnaces and was also applied to all converter smoke; but it was not applied to the reverberatory furnace smoke, in spite of the fact that we feed these furnaces practically continuously and with a dry preheated charge. It is true, there is some dust-loss from our furnaces, but the best test that we could make indicates that it would scarcely pay to go to the great expense of treating the large volume of reverberatory gas in the Cottrell plant. So far as we can determine, the mechanical loss—that is, all the loss apart from the slag—at this plant amounts to about 0.8% of the total copper content. When we first started the plant, we found with this class of material—flotation concentrate—there was a tendency to liquation in the reverberatory furnace, that is, the iron oxide would tend to combine with a part only of the silica, and liquate out with the matte, leaving a silicious putty-like mass floating on the charge, which caused the copper content of the slag to be abnormally high. Mr. Howard has adopted the method of tapping his reverberatory slags on a line above the matte but below this crust, and finds that after a certain amount of the crust has accumulated it fluxes off at the bottom about as fast as it accumulates on top. Careful tests extending over 18 months have shown that by this method he has saved about 50 tons of copper per month.

Won't you say something about the New Cornelia enterprise?

In 1911, John C. Greenway took an option on the controlling interest of the stock of the New Cornelia Copper Co. on behalf of the Calumet & Arizona Mining Co., and started drilling operations at Ajo, Arizona. The results of his drilling operations indicated about 11 million tons of oxidized copper-bearing monzonite, averaging about 1½% copper, and some 40 million tons of sulphide material of about the same grade. Later on, through cash and stock purchases, the Ajo Consolidated Copper Co.'s physical property was acquired, bringing the tonnage of oxidized ore to about 14 million tons, and, with additional drilling, increasing the sulphide tonnage to something over 50 million tons, with further possibilities.

From whom was the Ajo Consolidated property purchased?

From James Phillips, Jr. The ore is a granitic rock, usually called monzonite-porphyry, containing copper minerals associated with little, if any, pyrite, but with some magnetite. As is usual in deposits deficient in pyrite, the copper did not migrate, but was oxidized *in situ*. There is scarcely any zone of secondary enrichment between the oxides and sulphide, and this secondary zone is very thin. It was evident that if the oxidized material could not be treated commercially it would be simply an overburden, which would have to be mined and thrown away, whereas if it could be treated commercially it at once became an asset instead of a liability; an open-pit mine with practically no overburden could be started, and ore would be at hand with the first rock that the steam-shovel lifted.

The decision to treat the orebody by a leaching process required some courage.

Like the new mines that have come forward through the improvement in metallurgical process, the outcome was based upon the opinion of the engineers associated with the project. This point was thoroughly realized by Colonel Greenway and myself, and we spent several years studying the subject in conjunction with competent engineers. In this conection, we consulted Stuart Croasdale, F. L. Antisell, and the firm of Pope & Hahn. Our own engineers included James A. Potter and Henry A. Tobelmann. The tests originally were made at Douglas on small amounts of ore brought from Ajo. Later, a one-ton plant was erected at Ajo, followed by a 40-ton unit. The results were so encouraging that we jumped from the 40-ton unit to the 5000-ton plant that is now in successful operation. Once the process was decided upon, the work of construction proceeded, and Mr. McGregor was employed to design the plant under the direction of Colonel Greenway and myself. The process is simple. We found that a high extraction could be made on the oxidized ore with a dilute solution of sulphuric acid. We found that, although considerable amounts of alumina and iron oxides were dissolved, the former salt gave little trouble in electrolytic precipitation, and the latter could be controlled through the use of sulphurous acid. In consequence, we decided to recover the copper in major part electrolytically, reducing the ferric sulphate to ferrous sulphate by subjecting the solution from the leaching-vats to the action of sulphurous gas before it went to the tank-house for treatment.

In what way is the SO_2 reduction applied?

The entire process has been described technically by Tobelmann and Potter. The chief feature is the establishment of an enormous surface of contact between the liquid and the gas. Necessarily, as the iron and alumina accumulate, a portion of the solution has to be discarded. A part of the copper from this discard is then recovered electrolytically, and the remainder by precipitation on scrap-iron. Most of the cement-copper thus produced is re-dissolved with a corresponding reduction of a portion of the ferric iron.

In other words, you use the cement-copper in part to reduce the ferric sulphate?

Yes. The plant has worked successfully, and has treated several million tons of ore, producing copper at a low cost.

Did you draw upon the experience of others?

No, I cannot say that we did. We used whatever information we could get, but there is absolutely nothing in common between our work and that at Rio Tinto, for example; and the splendid work of Cappelen Smith at Chuquicamata did not apply to our ores or conditions.

I understand that your associates have become owners of an oilfield in California?

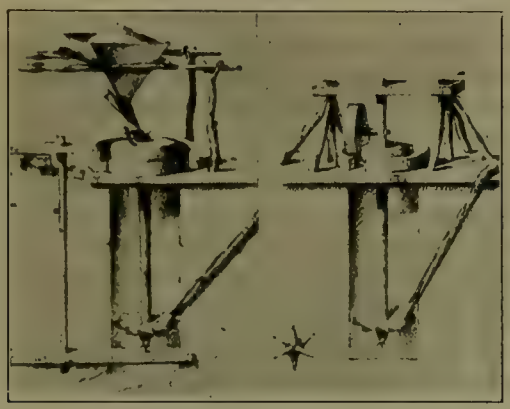
Two companies with which I am connected have purchased the old Peerless oil property in the Kern River field in California and are operating it under the name of the Arizona Oil Co. This purchase was not made, because the companies wished to enter into a new industry. They considered the property well worth the purchase-price, but, still more important, its possession protected their fuel supply. At present the oil for the copper industry of Arizona is coming almost exclusively from Tampico, and the oil that the Arizona Oil Co. produces is sold on the market, but with an agreement, any time we wish, that Inspiration and International will be furnished with California fuel-oil up to total requirements.

This means that, in case of a revolution in Mexico, you would have not only the supply from your own property, but the oil company would also provide you with whatever more was necessary?

Yes, within reasonable limits. Two things are now coming up, of exceeding importance. One of them is the assurance of a fuel-supply, because, not only is the cost of coal nowadays tremendous, but the Trinidad and Raton coals are not well adapted to reverberatory work. I feel that the cutting off of our oil-supply in the South-West might force the development of methods other than the fire process for the reduction of copper. We can probably obtain our power from other sources than coal or oil—that is, from streams—but I am inclined to believe it is possible that, rather than operate with high-priced impure coking-coals as smelting-fuel, we would develop wet methods for the treatment of sulphide and mixed ores, with the direct production of refined copper. The other important point is the necessity of decreasing the present freight-rates. I have recently had a study made of what the increase in freight means to four of the large mines with which I am connected, and it shows that if operating somewhat under normal capacity these mines would be now paying out in direct freight $3,500,000 a year more than they would have paid if 1916 rates prevailed. This amounts to an increase in direct freight charges alone of about 1½c. per pound of copper. In consultation with other mine operators in the South-West I find they check out about the same increased cost due to increased freight charges. Under normal conditions the South-West, including New Mexico, Arizona, and northern Sonora, can produce about 800,000,000 lb. of copper, which means an increase in direct freight paid of about $12,000,000 a year (77%) for the entire district. This has nothing to do with increased costs of labor or supplies. Recently there has been a tendency toward some reduction in freight, and it would appear that shortly a rate of $16.50 on copper will go into effect, being a reduction from a maximum of $22 per ton, but still some 65% higher than the pre-war rate. The railroads are in a very difficult position; their business has been disorganized, and operating expenses are far higher than they were formerly; unless freight rates can be reduced, either the public will have to pay a sufficient price for copper to absorb the increased freight, which it does not show any inclination now to do, or the mines must continue idle, as they now are, or a new outlet to tidewater must be provided.

Ancient South American Milling and Amalgamating Practice

*The *trapiche,* or mill, for grinding gold and silver ores, is a simple and rude piece of mechanism; its moving power is constructed after the same fashion as the mills used throughout Chile, and in some parts of Spain and France, for grinding corn. A place is chosen where a small current of water, whose section will present a sur-

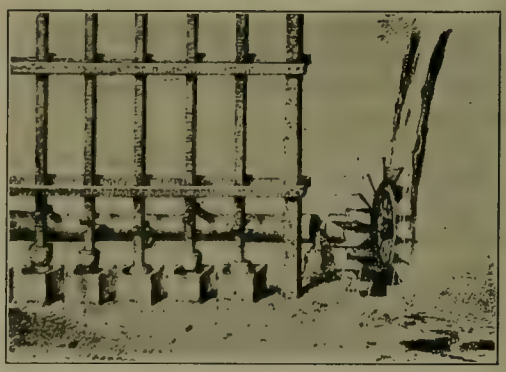


LEFT: 'TRAPICHE' USED IN CHILE FOR GRINDING ORES
RIGHT: FLOUR-MILL

face of six inches in diameter, can be brought to a spot where it can fall perpendicularly ten or twelve feet. At this place a well is built of this depth and about six feet in diameter; in its centre is fixed an upright shaft upon a central brass pin; it is confined above by a wooden collar. A little above its foot, the shaft has affixed to it a small wheel, around which are fixed a number of radiating spokes that are shaped at the ends somewhat like hollowed cups; these form a horizontal wheel about four feet in diameter. Upon the periphery of the cups, the jet of water is made to impinge with all the force it has acquired in falling down an inclined and nearly perpendicular trough, formed by scooping out the solid trunk of a tree. The application of this force causes the wheel to revolve with a quick rotatory motion. The arm extends about six feet above the top of the well; at about half this height is fixed a small horizontal arm, four feet long, which serves as an axle to a ponderous stone of granite, whose diameter is from four to six feet, and which is made to roll upon its edge in a circular trough that is sometimes made of granite, sometimes of hard wood.

The weight of this stone, assisted by its velocity, effects the pulverization of the ore; in some cases it is taken out in a dry state and subjected to the application of sifting, in order to separate the finer powder for amalgamation, and the coarser parts are thrown again into the mill; but more generally, in order to save labor, this separation is accomplished by the action of water. For this purpose a small stream is made to trickle into the annular trough, by which means the pounded ore is mixed into a state of mud, the finer particles being sufficiently attenuated to run off with the superfluous water through a notch made for the purpose in the margin of the circular trough; this is received in little pools, where the pounded ore is left to settle; the clear water runs away, leaving the powder at the bottom, to be taken to the place of amalgamation.

The *ingenio,* or stamping-mill, is moved by water by means of a small undershot wheel, five feet in diameter and one foot broad, the float- or paddle-boards of which are about one foot square, and move in an inclined trough, down which water is allowed to run. The impetus of the water falling upon the float-boards causes a quick revolution of the wheel, which is fixed upon one end of a long horizontal shaft, furnished with five or six cams at different places around the shaft, so that one is made to act as soon as the other has ceased its operation. Behind this shaft are arranged as many rods as there are cams, each furnished with a projecting tooth, against which, at every revolution of the shaft, the cam comes in contact, and thus lifts the rod a small height, which again falls down by the action of the cam. Each rod is furnished at its bottom with a copper hammer, or pestle, weighing 200 lb., which works in a mortar of stone or hard wood. At every revolution of the shaft, each of these hammers



'INGENIO' OR STAMP-MILL

will make a blow in succession, and by this contrivance the ore that is put into the mortars is pounded. In those places where the ore is ground dry it is required to be sifted; this is generally effected in a large box, in which a circular cylinder is worked by a common winch-handle, its periphery being covered with pieces of coarsely woven

*Abstracted from 'Travels in Chile and La Plata', by John Miers; published in 1826.

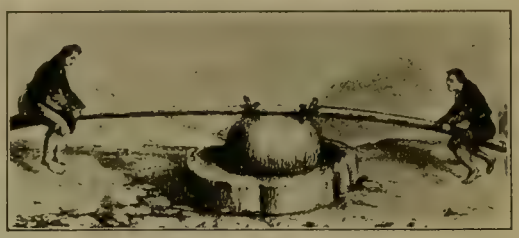
hair-cloth; the finer particles pass through the sieves into the box, while the coarse fall out at the opposite end of the cylinder, which is inclined for this purpose.

The amalgamating floor, called the *cancha* or *patio de beneficiar*, is a level place in the open air, about twenty feet square. The finer pulverized ore is brought and deposited in heaps, containing each half a *cajon*,† which are separately kneaded into a mass called a *cuerpo*. They mix with each about two *quintales*‡ of salt and a quantity of dry mule- or horse-dung, which is incorporated well together, and turned over with a spade several times for two or three days, until it begins to ferment; they then add to it a certain quantity of quicksilver. The quicksilver is put into a soft goat's skin, bag, or purse, which they squeeze with the hand, so as to make it run in a shower of minute globules, the quantity of mercury used being apportioned to the nature and richness of the ore; those of silver require generally from 10 to 20 pounds to each *cuerpo*. Gold ores consume much less; the quantity is judged by experience. The mass is moistened with water, and kneaded by the pressure of the foot of the workman six or eight times every day. There are generally from 10 to 30 *cuerpos* upon the floor at one time, and the workman goes from one to the other in succession, until all are kneaded. He then begins again at the first, and so continues the operation, taking care after each kneading to beat up the mass smoothly in the form of a cone. In Chile, the heat of the sun is generally sufficient to ensure satisfactory amalgamation; but in some of the high table-lands of Peru, where the air is

'CANCHA DE BENEFICIAR.'. PREPARING THE 'CUERPOS'

cold, the amalgamating floor is built upon arches, under which a fire is maintained to preserve the necessary temperature. During the winter in Chile, the amalgamation often requires three weeks, whereas in summer eight or ten days is sufficient. When the process is supposed to be completed, the foreman takes a small sample of each *cuerpo*, washes it in a small earthen bowl, or in a bullock's horn, to separate the amalgam, and judges by its color and consistence whether it has reached the precise point. If the amalgam, or, as he calls it, *la pella*, be hard, more quicksilver is added to the *cuerpo*, and the mass is again kneaded. If on pressing the sample under the thumb it forms a cake, and adheres to the skin, the amalgamation is judged to have been carried to the correct point. If, in forming the cake, a portion of quicksilver escapes from it, the mercury is not sufficiently incorporated, and the mass is left to ferment some time longer. If the color of the amalgam be dark, more salt and dung are added, and the mass is again kneaded and fermented.

The *cuerpos* are then carried to the washing-places. The first of these is a small shallow square reservoir made



MILL USED TO GRIND THE CONCENTRATE

of brick and plastered with lime. Across this is stretched a sort of hollowed apron, made of a piece of hide, suspended at the corners from the angles of the pit. The reservoir is filled with water into which a fresh current is always running; the displaced water is made to flow along a narrow gutter into a second reservoir. Upon the hide apron the *cuerpo* is placed, and is carefully kneaded by the hand; the saline, vegetal, and earthy matters are carried off by the waters, and the heavier metallic particles fall into the concavity of the hide. Further off at short intervals in the course of the inclined gutter, are made four or five small reservoirs of the size and shape of inverted sugar-loaves. Across these, in like manner, are stretched small leather diaphragms, so that any very small metallic particles that may have escaped from the first reservoir, suspended in the running stream, may be deposited in these successive receptacles. The amalgam, by these means, is separated and collected at a trifling expense. When a sufficient quantity is collected, the *pella* is put into a woolen bag, shaped like a cone, with the point downward; it is then hung up, to allow the superfluous mercury to drain off. The mouth is then tied up, it is laid between two boards with a weight on the top, and the excess quicksilver is expressed. Thus the amalgam is shaped into cones, for distillation.

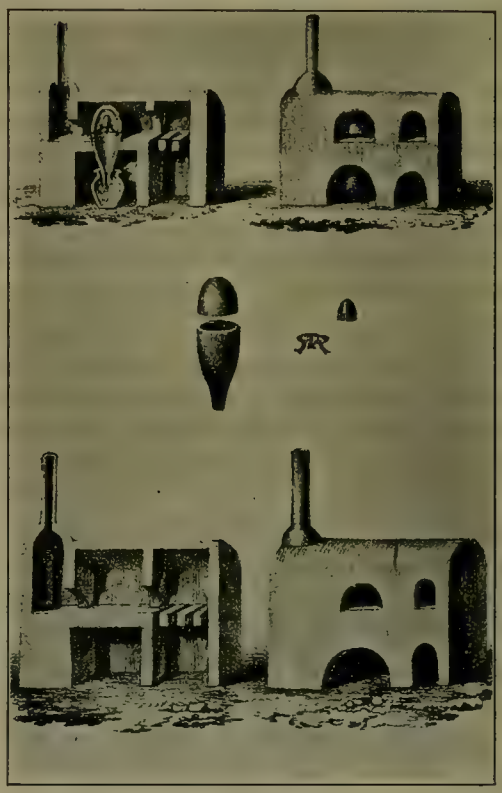
Another mode of extracting the gold, where it is minutely disseminated in grains in a soft rock, is by washing—a process much more economical, and adopted by the poor people. This can only be done where a small spring of water issues from the side of a hill. The place where the operation is effected is called a *lavadero*. The little springs often bring down into the ravine a large quantity of clayey matter that contains minute particles of gold, mixed with iron sand. It is usual to change the course of the stream to where gold is supposed to be most abundantly existing; and, to command a greater force of water from these little springs, it is advisable to form a pit on the side of the hill, and to bank it so as to accumulate a supply of water. The workman then scrapes the earth from the side of the hill and opens the embankment. The water flows over the collected earth and forms a small channel, by which the water, thus rendered muddy,

†A 'cajon' is a box, probably used as a measure.
‡A 'quintal' is about 100 pounds.

is conveyed to his hut. While descending the declivitous mountainside, no more apparatus is needed than a small gutter to confine the water; but, where it crosses a less inclined valley, the muddy fluid is made to flow down troughs that are hollowed from the trunks of trees. The operator continues to turn over and stir up the earth while the water flows over it, so that it may carry off all the earthy matter in which the particles of gold are suspended. After it is sufficiently washed, he examines carefully the stony and gravelly residue, for whatever *pepitas,* or large grains of gold, may be found, though rarely, disseminated in the rock.

The muddy water thus conveyed to the hut of the gold-washer is received upon a large stone, whose surface is in the form of a shallow basin. A notch in the exterior allows the water, which has in great measure deposited its heavier particles, to flow off, by means of another trough, to another similar stone basin, and in the same manner into three or four others in succession. The auriferous particles are thus allowed to deposit themselves in these receptacles, while the earthy lighter atoms, still suspended, are carried off by the running water. The gold thus collected is mixed with a quantity of ferruginous black sand and stony matter; the mixture must be triturated, a process that is effected in a rude and simple kind of *trapiche,* formed of two stones, the under stone being about three feet in diameter, and slightly concave. The upper stone is a large spherical boulder of syenitic granite, about two feet in diameter, having on its upper part two iron plugs fixed oppositely; to these is secured, by lashings of hide, a transverse horizontal pole of *canelo* wood, about ten feet long. Two men, seated on the extremities of this lever, work it up and down alternately, so as to give to the stone a rolling motion, which is sufficient to crush and grind the materials placed beneath it. The washings thus ground are subjected to the action of running water upon inclined planes that are formed of skins; by which process the silicious particles are carried off, while the heavier grains of gold, mixed with a portion of ferruginous matter, are extracted by a loadstone; it is again washed until nothing but pure gold-dust is left behind. The process is managed with much dexterity; and, if there were much gold to be amassed it would afford very profitable employment; but generally the small quantity collected is sufficient only to afford subsistence to the few miserable families employed at these works. It is probably the accidental finding of a rich prize on rare occasions that excites the constant hope of good fortune, and keeps the washers at this employment.

The distillation of the amalgam is effected in a sort of reverberatory furnace. It is constructed of sun-dried bricks and mud. Including the fireplace at one end, its length is fifteen feet, its breadth about four feet. The fireplace and hearth are raised four feet above the ground; the chimney is of small diameter. In the centre of the hearth is a circular hole, in which is cemented a conical earthen jar, two feet six inches long, and fourteen inches in diameter at the top, diminishing to half an inch in diameter at the bottom. This jar is so placed that the mouth is raised a few inches above the hearth. The nozzled bottom is received into a large earthen jar, filled with cold water, and placed in an arched chamber beneath the hearth. A circular grating made of hoop-iron stands upon three legs, the claws of which rest upon the inner edge of the mouth of the jar. Upon this grating, a tile is placed, and on it a ball of amalgam. A conical rounded head, of just sufficient capacity to contain the tripod and the amalgam, is made to fit closely upon the mouth of the jar. The joint is secured by a plastic lute,



AMALGAM-FURNACES

so that none of the vaporized mercury can escape. When the alembic is thus prepared, the opening at the side of the furnace is closed, and the fuel in the fireplace is lighted. The fire is briskly kept up during the operation, and, reverberating around the alembic, keeps it at a red heat, by which the quicksilver is converted into vapor, and is condensed in the earthen vessel placed beneath the jar, when it again becomes running mercury. The silver in a pure state remains in a porous mass upon the tile; it is called *plata en piña.*

THE value of the output of refined lead in the United States from domestic ores in 1918 was $76,667,000, as compared with $94,333,000 in 1917, a decline of $17,666,000, or nearly 19%, states a U. S. Geological Survey bulletin.

Agitation in Flotation

By Frederick G. Moses

Agitation, when considered in connection with modern froth flotation, has three functions:

1. The mixing of the oils or reagents in the pulp; or, as it is incorrectly called, the emulsification of the oils or other reagents.

2. The production of the air necessary for froth flotation. This step is more commonly called aeration.

3. As a means of increasing the circulation of the pulp in the flotation apparatus, the fundamental object being to cause the sulphides to be entrapped in the overflowing froth.

Each of these three functions is important, but the relative importance of each varies under special conditions: each is separate and distinct. All the three results mentioned may occur at the same time, and all may be accomplished by the same means; but this is usually for the sake of convenience, and not because the mixing of the oils and the aeration must be carried out simultaneously. In fact, there are many cases where these two phases of operation occur at different times and independently of each other.

Mixing. The general use of the term "emulsification" in connection with the mixing of oils or reagents in a flotation operation is incorrect, because of a careless interpretation of the word. Most authorities, when speaking of oil-water emulsions, give the impression that one of the principal characteristics of a true emulsion is its stability. Dr. Bancroft, in his recent book, says that, "The necessary conditions for forming a stable emulsion are that the drops shall be so small that they will stay suspended and that there shall be a sufficiently viscous film around each drop to keep the drops from coalescing".* He also calls attention to the fact that, "When a badly made emulsion is allowed to stand, it decomposes progressively".

Thus, if the oils were properly emulsified, the mixture should remain in an exceedingly fine state of division indefinitely, or for a long period. But the oils, to be effective, must coat the sulphides and the bubbles. If the oil is available for coating bubbles and sulphides, it cannot be thoroughly incorporated with the pulp; it should exist in a comparatively unstable condition, in order that it may be easily available. Bancroft says that, "anything which destroys the film destroys the emulsion. That is why acid destroys a soap emulsion".† The principal function of the acid may be to prevent the formation of a stable emulsion of oil and pulp. One of the principal influences in the production of stable emulsions in mechanical agitation machines is the violent agitation to which the pulp is subjected. It is possible that, in some cases, the pulp is too violently agitated, from the oil-mixing standpoint; and that the sulphuric acid is added to counteract this. The detrimental action of soap solution is well known; it is probable that this is due to the fact that the presence of such solution causes the oils to form permanent oil-water emulsions. If common salt has proved beneficial to flotation, as reported, this may be due to its property of destroying the stabilizing effect of soap films or other emulsifying reagents in oil-water emulsions.‡

On the assumption that emulsification may be carried too far, it is possible to explain why ¼ lb. of an oil added at four places in a series of cells will be more effective than 1½ lb. of the same oil added at the head of the cells. It would seem, also, that the agitation given to a pulp in order to distribute oil throughout it is unnecessary, provided that the oils could be mixed satisfactorily with the pulp by some other means, or provided oils were used of such a nature that they would be sufficiently divided without the necessity for agitation.

At many plants the oil is neither mixed nor distributed in the flotation machine; very heavy oils are used, which are difficult to mix with the pulp. In such cases the oils are incorporated in the pulp before it reaches the flotation machines, by adding them to the dry ore or to the ball-mills or pebble-mills that are used to grind the ore previous to flotation. Mixing by agitation may also be avoided by using oils that are light enough to be mixed sufficiently by the travel of the pulp through the mill launders, elevators, or flotation machines, or which distribute themselves throughout the water of the flotation feed. Many flotation operators state that they cannot use crude coal-tar, or other heavy oils, because of the difficulty of emulsification. As an alternative, certain lighter fractions, which do not require the violent mixing, are being used; results are as good or better than those obtained by the use of heavy oils. It is not the intention to give the impression that heavy oils are not required, nor that, in certain flow-sheets, the violent mechanical mixing is not desirable. The latter is necessary when coarse sand is being treated, and when this class of mixing is required to keep the heavy constituents of the pulp in suspension. Other special cases might also be cited.

Aeration. Aeration, as applied to flotation, has always been a much-abused word. Flotation was unsuccessful until the importance of air was appreciated. Formerly, the production or incorporation of air in the pulp was considered an unimportant adjunct to violent agitation and its function of mixing oil and pulp.

Air has three important functions, and one unimpor-

*'Applied Colloid Chemistry', p. 261.
†Ibid, p. 268.
‡Ibid, p. 262.

tant function in the froth-flotation machine. It is necessary in order

1. To increase surface-tension or air-water interface, so that the froth may float.

2. To give air-water interfaces on which the sulphides can attach themselves.

3. To furnish a substance which, when associated with oil, will tend to attract the sulphides.

4. To give an upward direction to the pulp, and so to bring the sulphides in contact with the floating froth.

A bubble consists of a spherical liquid envelope enclosing a gas. Froth is an aggregation of bubbles on the surface of water or pulp. In order to produce the froth that is needed to support the sulphides on the surface of the pulp, a large quantity of air is necessary. The oil, in order to be of use, must spread out in a thin film on the surface of the water or of the bubble. This surface is not available unless sufficient air is present to furnish the gas with which the water can form an interface on which the oil can spread. Bubbles are coated with oil when deep in the machine; the air must be introduced into the body of the pulp. Hence the necessity for aeration, or the incorporation of air in the pulp. A sulphide will not float readily if wetted by water. It is the air that displaces the water and prevents it from wetting the sulphide. Air, or some other gas, must be present in the water to prevent it from wetting the sulphide. This suggests a third reason for the presence of air in flotation pulp.

In all modern flotation machines the sulphides are associated with the froth on top of the pulp. To effect this, it is necessary to carry them upward, or to throw the pulp into this floating froth. Air bubbles in water will rise. Therefore, the air that may be released at the bottom of a pulp column rises to the surface, carrying the sulphides with them. Another method of obtaining the result is to give the pulp an upward direction of flow.

Introducing Air in Flotation Pulp. Methods of introducing or utilizing air are as follows: (1) By mechanical agitation; (2) by positive pressure on the pulp, or by blowing compressed air into it; (3) by negative pressure, or by subjecting the pulp to a vacuum; and (4) by the production of some insoluble gas in the pulp.

The aeration of flotation pulp by mechanical agitation is secured by direct or indirect suction, whereby the air is sucked into the agitating chamber of the machine, and is there entrapped in the pulp. This aerated pulp then flows to a spitzkasten or settling box, where the entrapped air is slowly released, and rises in the form of bubbles to the surface of the pulp. All mechanical-aeration machines depend on this principle, regardless of the kind or shape of the agitator or the form of the box in which it revolves. Some types of machines draw the air into a vortex formed by the rapid revolutions of the propeller; others suck the air down a hollow shaft; a few depend on sucking the air through openings in the machines or through open shaft-ends. Some types are peculiarly adapted to certain conditions; some are efficient as mixers and some are efficient as aerators, but the principle in each case is the same.

Pneumatic Machines. The so-called pneumatic machines constitute the second most popular type of flotation apparatus. In these the agitators are usually omitted. The heavier oils are mixed before the pulp reaches the cells, and the air is blown directly into the pulp through porous-canvas, porous-brick bottoms, or by means of pipes that are submerged in the pulp. The air is produced by a low-pressure blower. This, is, undoubtedly, an efficient method of aerating the pulp; but the absence of agitators is sometimes a disadvantage.

The Vacuum Process. One of the first successful frothing processes of flotation was the Elmore vacuum process. Although thus termed, its success depended on aeration. The difference between this process and the pneumatic process is in the source of air. In the latter, atmospheric air is furnished by a blower; in the Elmore process, the air used is that which is dissolved in the water in the pulp. Of course, ordinary water contains air. Under most operating conditions there is sufficient air in the pulp to furnish enough froth for successful flotation. The dissolved air in the Elmore process was made available for froth formation by subjecting the oiled pulp to a reduction in pressure, by placing it under vacuum. The dissolved air came out of the solution in the form of fine bubbles, which rose to the surface and carried the sulphides with them.

Carbon Dioxide Process. In this process, limestone and acid were added in the correct quantity to produce bubbles of carbon dioxide gas that, as they rose to the surface, carried the sulphides, and formed the supporting froth on the pulp surface.

Direction of Pulp Flow. Bubbles rising in the pulp will carry sulphides with them, but only a proportion of what is found entrapped in the froth reaches the surface in this way. The remainder are entrapped by being thrown into the froth, by agitation and circulation. On inspecting the operation in a machine with a glass side, the bubbles may be seen to carry their burden of sulphides upward. The pulp moves in such a manner that a stream is continuously in contact with the floating froth. As the material moves up into this layer, both sulphide and gangue are entrapped and held, with different degrees of tenacity. The sulphides have the greatest affinity for the bubbles; they are gradually carried to the top of the froth column and over the lip of the machine. The gangue is not held so closely, however; it is separated from the froth and finally drops into the pulp. In fact, the degree of this dropping has much to do with the grade of the concentration obtained, and the ratio between the grade of concentration and the extraction. The importance of this method of entangling sulphides in the froth is being realized by flotation operators. It is influencing the design of machines, tending to make them shallower and to cause the feed to enter the machine, not at the bottom but at the top of the pulp. The amount of sulphides that get into the froth in this manner is dependent on the direction of flow given to the pulp by the agitator and the baffles in the machine. It would seem that this function of agitation is most important.

CHILE COPPER PRODUCED METAL FOR 11.012 CENTS AT CURTAILED CAPACITY

The Chile Copper Co. has been cutting its operating costs by reason of the depreciation of the peso, although not to the extent that would be possible were the property running at full capacity. During the war period, when the United States was importing nitrates and copper from Chile but sending next to nothing down there except supplies for American-owned properties, exchange went against the dollar to such an extent that labor costs and other items paid for in pesos were higher than ever before. The dollar may now purchase about ten of the Chilean monetary units. The company has reduced output from a monthly yield of 12,000,000 lb. to below 5,000,000 lb. It cost the company 11.012c. per pound to produce its copper in the first quarter of the year, against 11.262c. in the final quarter of 1920. Costs included selling and delivery expenses, but excluded depreciation and Federal taxes, and gave no credit for miscellaneous income. The June 30 statement is expected to show a further cut in costs.

CONSOLIDATED COMPANY OFFERS BETTER TERMS FOR SMELTING ORE

Whether the entry of the Federal Mining & Smelting Co. into the Kootenay lead-zinc district in British Columbia has had anything to do with the sudden change in the plans of the Consolidated M. & S. Co. is not known; however, the Consolidated company, after refusing to give anything but ware-house receipts for the metal content of ores treated since the beginning of the year, suddenly invited the independent mine-owners to a conference at Nelson to discuss fresh clauses for a new schedule of smelting charges. The meeting was a fairly representative one, and included James Anderson, of the Ruth mine; L. R. Biggar, Ottawa mine; Randolph Bruce, Paradise mine; Wilfred Cameron, Rambler Cariboo; Clarence Cunningham, Cunningham group; S. S. Fowler, Blue Bell; R. V. Grimes, McAllister; Paul Lincoln, Noble Five; J. P. McFadden, Rosebery-Surprise; J. B. and Oscar White, Silversmith; and W. E. Zwicky, Cork-Providence, representing the independent mine owners; and J. J. Warren, president; S. G. Blaylock, general manager; and T. D. Bingay, comptroller, of the Consolidated. The tentative proposal put forward by the Consolidated and, after some discussion, approved by the independent owners, probably will form the basis of the new schedule that will go into effect practically at once. The company will pay for 95% of the silver and 90% of the lead content, irrespective of the zinc content, 90 days after sampling of ore. In the previous schedule heavy penalties were made for zinc in excess of 10%. The treatment charge for zinc in such ores is to be reduced from 60c. to 50c. per unit. Prices will be based on London, instead of New York quotations. The company proposes to lower its deduction for exchange from 5% to 3%; this affects only the silver, nearly all of which is sold in the United States. As the independent owners demurred at the 90-day settlement, the company amended it, offering to issue 90-day notes on day of sampling, which may immediately be discounted at the local banks. The independent owners appear to be satisfied with the result of the conference, and it is expected that considerable activity in the Slocan will result.

HOLLINGER CONSOLIDATED HOPES TO INCREASE CAPACITY BY USING ROD-MILLS

A rod-mill is to be installed in the mill of the Hollinger Consolidated Gold Mines Co., at Porcupine, Ontario. If the mill proves capable of grinding as much ore as the manufacturers claim, additional mills will be added to increase the capacity of the plant. The company is now crushing 3200 tons of ore per day, which figures will be increased by 500 tons immediately. It is reported that a capacity of 5000 tons per day may be obtained if the experiments with rod-milling are successful. Production from the mine has recently returned a gross income of $900,000 per month, thereby making the Hollinger one of the leading gold mines of the world.

UNITED VERDE EXTENSION BUYS COAL MINE

Consummation of a deal whereby the United Verde Extension Mining Co. acquires 200 acres of coal rights near Gallup, New Mexico, was announced upon the return to Jerome from New Mexico, recently, of George Kingdon, general manager of the U. V. X., E. E. Campbell, mine superintendent, R. L. D'Arcy, engineer, and A. H. Favour, attorney for the company. The coal rights were purchased from the Mutual Coal, Light & Power Co. of Gallup, which has been operating a mine near that town. In connection with the taking over of all of the company's coal rights, the United Verde Extension has acquired right of way for a spur-track connecting the main line of the Santa Fe railroad with the hoist and tipple of the mine, so that coal can be produced on a large scale for shipment to the company's smelter at Clemenceau.

Inasmuch as about 40 acres of the mining property involved in the deal lies within the town of Gallup, the Mutual Coal, Light & Power Co. is retaining surface rights to the land which it is subdividing into town lots and placing on the market. No definite plans for the development of the newly acquired coal rights have been made as yet, on account of the shut-down of the U. V. X. smelter. For the present the Gallup mine will be leased by R. H. Wypur and associates, coal operators of Gallup.

MACHINERY MANUFACTURERS IN DENVER WILL CO-OPERATE IN PRODUCTION

The Denver Engineering Works Co., the Colorado Iron Works Co., the Stearns-Roger Manufacturing Co., and the Queen City Foundry Co., of Denver, have organized a new corporation to be known as the General Iron Works Co. During the coming year the new company will erect a complete modern plant to include machine-shop, foundry, and plate, structural, and pattern departments. A new building 100 ft. wide and 600 ft. long, together with warehouses and storage buildings, will be built near Denver. The object of the plant is to increase the efficiency and scope of production for each of the companies mentioned. Each will retain its identity and will continue to do business along the same general lines as heretofore, except that manufacturing will

be done in the new plant instead of in separate plants as heretofore.

DANIEL GUGGENHEIM, BACK FROM EUROPE, COMMENTS ON THE OUTLOOK FOR COPPER

Daniel Guggenheim, returning from Europe, says that German constructive activity, contemplated electrification of Swiss railways, and water-power development in Italy and elsewhere all gave promise of substantial demand for copper from abroad. He declared, however, that copper producers should devote their main efforts to the development of domestic business, and that, he said, meant getting building started. Mr. Guggenheim indicated that no attempt to increase copper production would be made until greatly increased orders should warrant such action.

Mr. Guggenheim considered high labor costs the principal factor retarding building, and he denounced generally "unsatisfactory and unscientific" methods of handling labor questions.

"Labor leaders should teach their followers that deflation must take place in wages as well as prices, or the industrial situation is disarranged and dissatisfaction to all concerned is the result. It is unscientific to deflate labor by closing factories and throwing men out of work. Labor is entitled to a higher rate of pay than it had in 1914, but for most occupations a lower rate than is now paid is necessary to bring wages in line with prices of materials and products."

THE PROPOSED MINING LAW

The important points of difference between the existing statutes applying to the location and patenting of mining claims, and the proposed new Federal Mining Act, have been arranged in concise form by M. W. von Bernewitz of the U. S. Bureau of Mines. His compilation, which gives the salient features in a convenient table, follows:

Provision	Proposed Law	Existing Law
Discrimination in type of deposit	Lodes and placers alike	Lodes and placers distinct
Size of claim, acres	40	20
Shape of claim	Square	Rectangle
Survey lines	Conform to public lands	Any lines
Discovery of mineral needed before location?	None required	Discovery required
How long can claim be held without discovery? years	5	
Terms of extension	Payment of $50 per acre or $2000	
Annual assessment work	$5 per acre, or $200	$100
Alternative of assessment	$5 cash per acre or $200	
Failure to comply with law	Open to re-location	Open to re-location
Period for assessment work or cash payment	Calendar year*	Fiscal year (noon July 1)
Extra-lateral rights	None	If vein outcrops on claim
Boundaries of claim at depth	Vertical on all sides	Vertical at end-lines
Period before patenting, years	5	5
Discovery of mineral needed before patenting?	Yes	Yes
Rights of locators prior to proposed law	Valid	
Annual work needed before patenting	$20 per acre or $800	$100 a year or $500
Alternative of annual work	$20 per acre or $800	
Final payment before patenting	$5 cash per acre or $200	$5 cash per acre or $100
Area of non-adjacent, non-mineral mill-sites, acres	10 or unlimited for large-scale operations	5
Tunnel-rights	Limited to claim boundaries	Within 3000 ft. from the face
Minerals not covered (Leasing Act of Feb. 1920)	Coal, oil, oil-shale, phosphates, potasn, sodium	
State regulations	Repealed	In force with Federal

*As the period under the existing law has recently been changed from the calendar to the fiscal year, no doubt the proposed law, if passed, will be altered also in this regard.

ARIZONA

Bisbee.—Copper products fabricated experimentally at the electrolytic plant of the New Cornelia Copper Co. at Ajo are on exhibit at the Lowell store of the Phelps Dodge Corporation. A prize of $50 is being offered by the Calumet & Arizona Mining Co. for the best suggestion for either increasing the uses of copper or the manufacture of some specific article that will accomplish the same purpose. The display consists of auto and house radiators, copper road-signs, sheet copper, master phonograph records, and other small articles all manufactured electrolytically at Ajo.

It is reported that a body of ore running 20% copper has been cut on the 750-ft. level of the Night Hawk Leasing Co.'s property. It is believed that this ore is the same as that recently opened in a winze on the 650-ft. level on the Lone Star claim.

Clifton.—Following an examination of the property of the Stargo Mines Co., near Morenci, by engineers representing Eastern capitalists, an agreement has been reached by which funds are to be provided for the erection of a mill and for deeper development work. Under the agreement the remaining treasury stock is to be sold. This new work is expected to be started within 60 days. Plans for a cyanide plant are now being prepared by the General Engineering Co. of Salt Lake City, the necessary experimental work having already been completed. The Stargo group of claims lies about a mile and a half south of Morenci, having been finally purchased in June 1920 after a three-year option by the Stargo Mines Co. For two years prior to the closing of the Calumet & Arizona smelter at Douglas regular shipments of ore were made.

Douglas.—The directors of the Hill Top Metals Mining Co. were re-elected at a recent meeting held in Douglas. They are R. O. Fife, A. C. Jones, and R. O. Fife, Jr., who is also general manager. The manager's report stated that

development work would continue at the mine along the same lines as during the past eight years during which time over $500,000 had been expended. The property is being opened by adits through which the ore will be taken to the mill to be erected.

Jerome.—Sinking at the Verde Central shaft is continuing, although the new machinery ordered has not been installed. A depth of 25 ft. has been reached and the shaft will be continued another 275 ft. Development is also being carried on in the drift-level. Two shifts are now being employed and a third will be added when the machinery is installed.

Kingman.—High-grade gold-silver ore has been opened on the Old Dad property situated two miles north of Hibernia in the Wallapai mountains. A. L. Runyan and associates are driving a tunnel and sinking a shaft on one of the several veins which traverse the claims.——Ore running as high as 289 oz. silver and $8 gold per ton has been opened in the Old Occident mine at White Hills.

Tucson.—The Yellow Bird Silver Mining Co. has been incorporated to operate the Lincoln group of claims situated 30 miles south-west of here. An adit, which will be run, is expected to tap the Providencia vein system at a point 250 ft. from the portal. The surface indications are said to be promising.

CALIFORNIA

Bridgeport.—A company, capitalized at $150,000, has been formed to establish a plant on Mono lake to extract the mineral salts from the water. The company is incorporated by W. S. Wentworth of Alameda, George C. Holbrook of San Francisco, and Leonard E. Wing of Sacramento. Utilization of the mineral salts in the Mono lake water has been discussed for half a century, it being known that they formed a valuable washing powder, and could be used as the base for shampoos and other cleansing preparations.

Chico.—According to J. A. Wisebaum, head of the Evening Star company, a fair recovery of platinum has been made by cleaning the sluice-boxes after a recent run. A prospector in the vicinity has also found platinum on Little Butte creek three miles south of Magalia on what is said to be the same channel as that being worked by the Evening Star company.

Downieville.—A road has been built for transporting by auto-truck the ores from the Wheeler Extension to the Hughes & Cameron mill. If operations are successful the mill will be moved to the mine.

Grass Valley.—The North Star company has resumed operation of its plant at full capacity. According to Arthur Foote, superintendent, 60 stamps are crushing medium-grade ore; 400 men are employed by the company.——Eighty stamps are dropping regularly at the Empire mill.

At the Idaho-Maryland mine, being re-opened by the Metals Exploration Co., the 600-ft. level has been placed in condition for mining. Mules have been purchased to do the hauling on the 1000-ft. level.

Randsburg.—John M. Fox, superintendent of the California Rand Silver mine, reports that the south drift on the 450-ft. level has improved in grade, the ore now being shipped. Stopes 913 and 450 continue to produce their customary amount of shipping ore. Stoping will shortly start above the 450 south drift, east of raise No. 914. Plans have been made for the building of a reserve of mill-ore in shrinkage stopes. This work has been hampered somewhat by lack of compressor capacity; with the installation of the new compressor ordered some time ago, additional stoping machines will be put into service and will relieve this shortage. The new working shaft has a total depth of 395 ft. The water shaft at Indian well has a total depth of 184 ft. Mill construction is proceeding satisfactorily, the arrival of machinery is expected daily.

A number of options have been given on good looking prospects in the silver 'zone'. The sinking on the Silver King, near the north lines of the California Rand Silver, continues; also on the Flat Tire group, farther north. Owners of the Capitolia group will soon be operating, according to reports. At the North Rand Silver, the collar for the 70° shaft has been placed.

Sonora.—The boarding-house at the Belmont Shawmut mine was recently destroyed by fire. Re-construction will be hastened in anticipation of resuming operations in the mine and mills.

West Point.—The Lone Star Keltz mines are being operated by the West Point Consolidated Mines Co., of which J. B. Statler is superintendent. Within the last four months complete new equipment has been installed at the Lone Star shaft.

COLORADO

Aspen.—The Silver Mines Co. of America has temporarily closed the Hunter Creek mill for the installation of equipment for use of the 'so-called' Brown flotation process. The Cowenhoven tunnel is being placed in shape for transportation of ores from properties acquired along the line of the tunnel; these now are being developed.

Bonanza.—The Baltimore Leasing Co. has opened a strong and rich orebody on the Baltimore claim and the third carload shipment is now at the smelter.——The Liberty Bell, fully equipped and with ore in sight, has recently been sold to Missouri people by W. R. Benzie of Denver. Shipments made from the property show net returns of $132 per ton, chiefly silver.

Boulder.—The milling plant at the Yellow Bird mine is being repaired preparatory to continuous operation this winter. Nineteen sets of lessees are working in ore at the mine; dump ore will also be treated.——The electrolytic plant at the Telegraph mine at Ward has resumed treatment and will be kept in operation until such time as the mine closes down for the winter.

Breckenridge.—The Boyce brothers are preparing a shipment from their recent surface discovery on the June Bug, to be consigned to the A. V. smelter at Leadville. The average silver content is around 500 oz. per ton.——A new vein recently uncovered on the Little Billie, in French gulch, is rich in gold and silver, with a fair lead-zinc content.——A steam-hoist has been installed on the Ground Hog group in Cumberland gulch preparatory to sinking an incline on the wide talc vein, opened by the Davis tunnel. The talc pans free gold.——Progress is reported with the prospecting cross-cut at the 300-ft. level of the 'deep shaft' by the Tymos Mining Co., the object of which is to explore the Ground Hog and Brooks-Snyder estates at depth.

Central City.—Ore opened in sinking a shaft on the Lone Star No. 2, at Hughesville, is reported as assaying 317 oz. silver per ton. The streak is from 4 to 6 in. wide. A pocket at 12 ft. yielded 600 lb. that returned 1100 oz. per ton from the smelter.

Colorado Springs.—Local mining men, owning interests in the Ramona lode claim at Cripple Creek have organized the Ramona Mill Co. and plan development of this old-time producer, now being operated by lessees. Ore sampling $80 to $150 gold, with some silver, has been opened on the Alpha and Omega, adjoining the Caledonia mine on the southern slope of Gold hill. The Caledonia, sold by the late W. S. Stratton to a British syndicate, was sold for taxes and debts and is now owned by a Denver man named Doran. The Alpha and Omega is owned by the Dig Gold Mining Co., but is operated under lease.

The Ajax Mines Leasing Co. has commenced shipments

from the Ajax mine on Battle mountain. Twelve sets of sub-lessees are reported working in ore.——Diamond-drills are in operation at the fourth level of the Cresson mine, and the core is reported showing strong 'mineralization'.

Georgetown.—Lessees in the Capital tunnel have opened high-grade copper ore on the Aetna vein and are preparing a shipment.——Work has been discontinued in the Smith tunnel by the Palisade company, and work has been started in the Wilcox tunnel to undercut the orebody recently cut in the Smith tunnel workings. The Burleigh mill is turning out a car of concentrate weekly.

Ouray.—The Hidden Treasure Mines Co. has acquired buildings at the portal of the lower tunnel formerly used by the Camp Bird company and surface rights to the land on which they stand. The new mill of the company of 50-ton capacity is nearing completion and a tram from mine to mill is constructed.——The force at the Atlas mine has been increased to nearly 100; production has been increased.

Pitkin.—A contract has been let for a 100-ft. extension of the tunnel on the Harbaugh group on Gold hill, to cut veins exposed at surface and in an upper tunnel; these produced $80 gold-silver ore, when last operated several years ago.

IDAHO

Coeur d'Alene.—The Pine Creek Mining Co. has followed the ore for 100 ft. and cross-cut it for 18 ft. About four feet of the vein matter on the foot-wall side is of a high grade and the remainder of the vein-filling is a milling ore. A drift is proceeding on the foot-wall streak, assays from which show 15.2% lead, 5.6 oz. silver per ton, and 7% zinc, while hand-samples of the mill-ore show 14.1% lead, 3.2 oz. silver, and 2.4% zinc. The outcrop of the vein consists of an iron-carbonate cap at least 30 ft. wide and extending 1000 ft. ahead of the present face of the adit. A depth of 750 ft. will be attained by the adit in following the vein. A compressor plant will be installed.

MICHIGAN

Houghton.—Investigators who have completed an industrial survey of the Lake district have come to the conclusion that from the standpoint of the mining companies the local fabrication of semi-finished copper and brass products is advisable. It is held that very appreciable savings can be effected thereby and that it is the only feasible way for the producers to advertise copper and themselves reap the benefits of an increased demand. A diversification of industries for community benefit is recommended. The survey was authorized by the counties of Houghton, Keweenaw, and Baraga. Whether it will bring about any change in policy on the part of the mining companies is solely a matter of conjecture at this time.

Further development of the Gratiot branch of the Seneca property will be watched with interest at the Lake. No. 2 shaft has opened rich ground from the 11th and 13th levels and the decision to sink to a depth of 4000 ft. to connect with the 3rd level of Seneca will prove up Gratio ground at depth and reveal the character of the Kearsarge lode in the extensive territory between the two shafts. The Gratiot shaft has been kept free of water and sinking can be resumed as soon as the new hoist is installed. The work will be pushed throughout the winter.

According to data prepared for the unemployment conference in Washington, only 16% of the copper mines of the Lake district active in normal years are now working and only 13% of the men are employed. There are 87 mines in the district; 42 of these work when conditions are normal, and only 7 are now operating. In 1916, a normal year, 17,900 men were employed; today the number at work is 2327. The operating mines are Copper Range, Quincy, Mohawk, Wolverine, Seneca, Mayflower, and Arcadian. The first four are producers while the other three are in the development class.

Of the 239 iron mines in Michigan and Wisconsin, of which 121 work normally, but 21 are producing.

Directors of Arcadian Consolidated have declared an assessment of 50c. per share, payable October 15. There remain in the treasury 43,630 shares of capital stock but it has been decided to retain this for future financing when conditions shall have become more favorable. A statement to shareholders says that development work in the New Baltic shaft has shown persistent mineralization.

MONTANA

Butte.—Lessees in the Walkerville district are producing good silver ore. J. W. Dailey has shipped sorted ore assaying 500 oz. silver per ton. His claims are on the south side of Oro Fino gulch. Kelsey & James have sunk a 126-ft. shaft where they cut a 3-ft. vein of ore averaging 75 oz. per ton. John Conway has good ore on the Glengarry claim.

NEVADA

Argentite.—The Natural Soda Products Co. is to build a mill at the Frances silver mine next year, according to F. H. Taylor, in charge of the property. The company employs 23 men at Argentite, according to Taylor, and there are 60 men in all working in the district. Among those developing claims owned by them or leasing on the Frances are Fred Mechlin of the Nevada-California Power Co., E. Marks, Tonopah and Goldfield merchant; Judge Ray, who has been prominent in Nevada districts since the days of Rhyolite; Ralph Paget, owner of the 5000-acre Butler ranch in Owens valley; the Cleary brothers of Silver Peak; Richard Raycraft of Tonopah; the Inmans of Silver Peak; Jud Collins, cattleman; John Shirley of Silver Peak; William Pagenkopf of Goldfield; W. T. Mitte of Goldfield; Bert Brown of Tonopah; James Edgar, Ernest Shirley, Bert Shiveley, Robert Neil, and Joseph McIvar. There is exposed on the surface of the Paget claims, one mile east of the Frances, a 27-ft. width of $14 ore. A shaft is being sunk in this ore and the bottom is in a 5-ft. width of $60 ore. Ernest Shirley and James Edgar have claims adjoining the Frances on the north, south, and east, and they have ore in several places. Shiveley and Neil have a full face of $37 gold ore in a cross-cut from a drift tunnel. This is the only gold ore found in the district. The vein is 50 ft. wide. Seven men are working on the Frances in prospecting the recent find of 1500-oz. ore 2250 ft. south of the main shaft and tunnel and on the strike of the vein.

Cuprite.—A 50-hp. engine and three-drill compressor are being erected at the 475-ft. shaft on the George S. claim of the Milwaukee group. There is exposed in a 6-ft. vein on the 475-ft. level an 8-in. width of ore assaying $56 in gold and 14 oz. silver. The 25-hp. hoist now at the shaft on the George S. will be moved to a 100-ft. shaft on the Walter E. claim and the latter shaft will be sunk to 400 ft. Recent finds in the nearby Hornsilver districts have resulted in a revival of interest in Cuprite.

Divide.—The shaft of the Tonopah Divide has been sunk 45 ft. from the 1000-ft. level. Shipments are being made at a rate of 5 tons daily, the ore coming from the 200 and 800-ft. levels.

Imlay.—A pump and a new hoist have been installed by the Majuba Fresno Silver Co., whose mine is 17 miles west of here. The last 44 ft. of an 84-ft. shaft is entirely in ore. Four cars have been shipped to Salt Lake Valley smelters that average $89 per ton.

Luning.—A small shipment of ore assaying 400 oz. silver has been hauled here from a prospect near the camp of Lucknow, nine miles north near the Rawhide road. An option on the property has been taken by Dr. F. E. Bass, of San Francisco, who paid the owners $1000 as first payment on a total

of $10,000. The ore has been stripped for 75 ft. on the surface.

Mina.—The West End Con. Mining Co. has taken possession of the Mabel group of claims in the Garfield district, west of Mina in Mineral county, which it purchased lately, and has secured an option from J. H. Miller and L. K. Gregory on the old Garfield mine adjoining. The Garfield mine produced $6,000,000 in high-grade silver ore when operated by an English company in the early '80s. It was never prospected below the main adit-level. The owners of the Mabel group have shipped $25,000 worth of ore from shallow workings. The West End is installing a compressor and will sink a shaft, first raising to surface from a shallow tunnel.

Pioche.—Dr. Walter Harvey Weed has issued a report on the Virginia Louise in which he estimates that the mine contains 1,318,750 tons of possible ore, not including that on the 833-ft. level or the zinc ore found by diamond-drilling. He recommends that the blocking out of ore be continued so that the company can make long-term contracts with smelters, or contract with a smelting company to work the mine and treat the ore on a royalty basis.

Rand.—High-grade ore has been exposed by a winze below the 150-ft. level of the Nevada Rand property, 15 miles east of Walker lake. W. V. Rudderow, the manager, says that men developing the property under contract have opened ore on the 200-ft. level assaying $100 per ton and from the seam of high-grade found in the winze, varying from 6 to 14 in. wide, they have taken 100 sacks of ore assaying $500 per ton. Samples of the first 50 sacks assayed 8.32 oz. gold and 550 oz. silver, or $722 per ton. Samples showing hornsilver assayed $1305 per ton. Ten tons from the winze will be shipped to the sampler of the Western Ore Purchasing Co. at Hazen.

Reno.—At a meeting of directors of the Eureka-Hamilton Mining Co., held in Reno last week, five offers for control of the company were considered and the board decided to reject the offer of the Tonopah Mining Co. W. H. Blackburn, manager for the Tonopah Mining Co., spent a week recently in sampling the property, situated at Hamilton, in White Pine county, and adjoining the once-famous Eberhardt mine on Treasure hill. Cyanide tests on the ore, made at Tonopah, indicate an extraction of over 90%.——The mining committee of the Reno Chamber of Commerce and members of the Nevada Mine Operators Association are studying the mining bill (H. R. 7736) now before Congress, and a concerted effort will be made to bring about its defeat. The bill seems to be generally regarded in the mining region as a serious menace to the industry.

Rochester.—Bullion worth $60,729 was shipped by the Rochester Silver Corporation, the result of its August operations. The bullion contained 45,083 oz. silver and 756.98 oz. gold. The mill treated 5271 tons. Development work for the month was 516 ft. The balance sheet showed net assets of $272,870. A dividend of 2½c. was paid on September 20.

Unionville.—The Universal Silver Mines Co. is developing a 2-ft. vein of $50 ore on the 1200-ft. level.——The Sierra Silver Mines Corporation is said to have uncovered a shoot of rich ore midway between the north and south contact veins.

Virginia City.—At the mill-site of the United Comstock Mines Co. in American Flat a number of large buildings are nearly complete and the first cottages for workmen are being erected. Concrete is being poured at the rate of 125 yards daily in the forms at the fine crushing plant and 12,000 yd. of concrete will be used. The mill-buildings will cover an area of five acres.——The Scheels inclined shaft of the Comstock Silver Mining Co. is being equipped with a small electric hoist. Work in this ground continues to expose ore of good mill-grade.——Old workings of the Pittsburg Comstock Mining Co. have been sampled by William Sharp, who has been retained as consulting engineer for the company. His report shows mill-ore for substantial widths at a number of points in the two tunnels and in surface workings.

UTAH

American Fork.—The Pittsburg Mining Co. is reported to have placed an order for an aerial tramway from its mine to the Pacific mill, a distance of 1.4 miles. An order has also been placed for 30,000 ft. of heavy timbers for the towers. It is expected that the tramway will be in operation before winter sets in.

Bingham.—The Montana-Bingham Mining Co. is one of the three mines now operating here; 70 men are employed. Imer Pett, manager, states that an average output of about

Hauling Ore from the Premier Mine in British Columbia

100 tons per day of low-grade copper, with a high excess of iron, is being produced and shipped to the Garfield smelter. Recent development work has opened some ore of high grade.

Eureka.—Directors of the Tintic Standard Mining Co., at their meeting on September 20, voted to pass the third quarterly dividend, which ordinarily would have been paid on September 30. During the first and second quarters of the present year a dividend of 5c. per share was paid. Last year dividend disbursements totaled 40c. per share. E. J. Raddatz, president of the company, stated that the directors felt that, in view of unusual conditions prevailing which tend to reduce the profit of mining operations, it was deemed advisable to omit the third quarterly dividend for 1921.

Shipments for the week ending September 17 totaled 158

cars, as against 137 cars for the preceding week. The Tintic Standard shipped 45 cars; Chief Consolidated, 35; Victoria, 12; Eagle & Blue Bell, 11; Dragon, 10; Iron King, 9; Iron Blossom, 8; Centennial-Eureka, 5; Mammoth, 5; Swansea, 5; Bullion Beck, 4; Sunbeam, 3; Gemini, 3; Colorado, 3; Alaska, 2; Tintic Drain Tunnel, 1.

Logan.—Last June a company known as the Silver Tip Gold & Silver Mining Co. was organized to develop claims 30 miles north of Kelton, a station on the Southern Pacific railway. An incline was sunk on an outcrop which showed $35 per ton. At a depth of 50 ft., an average sample gave returns of 1.4 oz. gold, 71 oz. silver, and 3.31% copper. At a depth of 80 ft., the ore had a width of 2 to 3 ft., 20 in. of which gave returns of $110 per ton. A small streak assayed 44.2 oz. gold and 351 oz. silver, or about $1235 per ton. J. R. Jones will continue development during the winter.

Ophir.—After years of inactivity, other than a small amount of work done by lessees at various times, announcement is made that the Eureka-Ophir property will be reopened on company account. J. W. Cairns will be manager of the property. The buildings at the mine have been repaired, a 25-hp. gasoline-hoist and compressor purchased, and supplies laid in for development during the coming winter. The property has been opened by a shaft to a depth of 400 ft. Above that level, it is said, about $175,000 worth of silver and lead has been extracted, while lessees have paid $11,000 in royalties.

Park City.—Owing to improved labor conditions, much exploratory work is being done at the various Judge properties, according to G. W. Lambourne, general manager. In a raise from the 900-ft. level at the old Judge mine, in the middle vein system, a new ore deposit of promise is being developed. The raise is now up 150 ft. from the 900-ft. level, and for the last 40 ft. has been in ore averaging 35 oz. silver and 35% lead, with a width of from 4 to 5 ft. In the Park-Utah property, work has been carried on from the Ontario lower drain tunnel, which is owned jointly by the Ontario and Judge companies. Approximately 8000 ft. from the portal a cross-cut to prospect the important fissures of the Park-Utah property was started. Several shoots of high-grade ore have been intersected by this cross-cut, which is called, temporarily, the 1800-ft. level. One of these shoots has been followed on the strike of the vein for a distance of 300 ft. Cross-cuts run at intervals of 60 ft., according to Mr. Lambourne, prove that the shoot has a width of from 5 to 27 ft. of shipping ore.

Ore shipments for the week ending September 17 totaled 1913 tons, of which the Silver King Coalition shipped 713; Judge companies, 548; Ontario, 412; and the Naildriver, 140. Shipments the previous week totaled 1354 tons.

WASHINGTON

Colville.—The Old Dominion mine in Stevens county is the scene of a discovery of exceptionally rich silver-bearing ore. According to reports the ore contains 1140 oz. of silver per ton, which is equivalent to $1140 per ton at the fixed quotation of $1 per ounce. It lies in a body 3 ft. wide. The find was made at a depth of 600 ft. in a tunnel driven 2150 ft. The grade is said to persist for the short distance the ore has been followed by the drift. W. H. Linney is president and general manager.

Northport.—Five or six boulders of lead, like those found in the Electric Point and Gladstone Mountain mines, have been met in sinking to a depth of 56 ft. in the property of the Keystone Lead Mining Co. in the Electric Point district. The shaft will be continued to a depth of 100 ft., where drifting will be started.

BRITISH COLUMBIA

Alice Arm.—Another strike has been made at the Bellevue mine, Illiance river. The lode is 1 to 3 ft. wide and composed almost entirely of fine-grained galena. It has been traced on the surface for 300 feet.

Cranbrook.—F. W. Beatty, president of the C. P. R., of which the Consolidated M. & S. Co. is a subsidiary, paid a visit to the Sullivan mine recently and to the company's power-plant, at Bonnington Falls. It is rumored that Mr. Beatty's visit is in connection with the erection of the first 2500-ton unit of the new concentrator at the mine, for which it is stated the Consolidated is proposing to borrow $5,000,000.

Hope.—Edwin T. Hodge, consulting engineer for the Liberator Mining Co., furnishes the following information about the Emancipation mine, which the company is operating. As a result of the work that has been carried on continuously for the past 15 months, 5000 tons of ore, averaging $20 per ton, has been blocked out on the two-foot vein, and 1000 tons, averaging $30 per ton, has been extracted. On the surface this vein has been stripped for 2000 ft. The ore in sight in both the large and small veins warrants the erection of a 50-ton plant. This mill will be built at the railway track, 2700 ft. from the mine, and will consist of a crusher, ball-mill, plates, classifier, pebble-mill, and cyanide tanks. It should be completed in 60 days.

Nelson.—The Nugget Gold Mines, Ltd., has re-started its mill, which has been closed for the last few weeks owing to a shortage of water. The mine is developing well; a profit of some $9000 being made in July, before the shut-down. ——J. B. Smith, president of Silversmith Mines, Ltd., has bonded the Bayonne group, at the head of Summit creek and about 12 miles over the summit from the Nugget mine. Supplies have been taken to the property, and development will be continued through the winter. This property is owned by James Gerrard, formerly U. S. Ambassador to Germany, and Thomas Hickey, of Butte.——The Reno group, in the Sheep Creek district, is said to be developing well. There are five veins on the property, ranging from 2 to 4 ft. wide and averaging in the vicinity of $20 per ton. A tunnel being driven on No. 1 vein will give 550 ft. of ore overhead. This vein is 3 ft. wide and in places runs over $100 per ton in gold. Work is to be continued through the winter.——After seven months of exploration, R. A. Grimes has succeeded in picking up the continuation of the ore-shoot on the other side of the fault at the McAllister. The shoot has 4 ft. of good shipping ore on the hanging wall.

New Hazelton.—A trial shipment of ore from the Harvey group, in the Babines, which was sent to the Tacoma smelter, gave a return of $316.39 per ton. The property is owned by the Balkis Mining Co., an Edmonton concern.

MEXICO

Durango.—Edward C. Bryan and Luis G. Gavaldon have re-located the La Rueda Minera mines, consisting of 15 claims, situated in the Villa Ocampo district. These properties were declared forfeited for non-payment of mining tax. They are being re-surveyed by Robert C. Colwell.

The smelting plant of the Penoles Mining Co. at Mapimi is being partly dismantled and the equipment moved to the Torreon smelter, which is owned by the same company. Work is being carried on at some of the principal mines of the company in the Mapimi district on a reduced scale, while the smelters at Torreon and Mapimi are closed for the change. The Penoles company also owns the San Toy, Inglaterra, and other mines in the Santa Eulalia district of the State of Chihuahua and is shipping its ores to the Avalos smelter, owned by the American Smelting & Refining Co., and situated a few miles from Chihuahua City.

P. W. Martinez has taken up some gold and silver properties in the Topia district west of Durango City. One of the new groups comprises three pertenencias to be patented under the name of Cuatro de Julio.

Chihuahua.—Charles Ballow, representing George Johnston and Albert H. Davidson, is opening up the Santa Rita and Santa Barbarita mines, in the Santa Barbara camp, municipality of Guazapares, in this State. The properties are situated near La Judia and Marco Antonio gold-silver mines. There are a number of old workings on the Santa Rita and Santa Barbarita, which will be cleaned out and sunk to a greater depth.——A 1000-ft. tunnel shortly is to be run on the Erupcion Mining Co.'s property in Los Lamentos mountains, east of Villa Ahumada. As development work on these properties continues, larger bodies of ore are exposed.

Stiles & Escobar, operating the Dolores mines in the Santa Eulalia district, have recently purchased the Continente mine, which they will operate in connection with their other properties. They expect shortly to begin the construction of a new concentrating plant of 50 tons daily capacity for treating their ores on the ground.

ONTARIO

Cobalt.—The outlook for the silver-mining industry has been improved by the increase in the price of silver, which has given a decided stimulus to the activity of the producing mines. The less important properties which remain closed are now in a position where resumption of work is possible. Shipments of ore last week were the largest for several months past, amounting to 313,095 lb., the O'Brien heading the list with 142,000. The Nipissing and Mining Corporation are confining their shipments to bullion.

Kirkland Lake.—Good results are being obtained at the Teck Hughes, where, according to an official statement, the mill treated an average of 88 tons of ore every 24 hours during the first six months of the year with a recovery of $10.34 per ton. The work for increasing the capacity of the mill to 150 tons per day is under way.

Officials figures for the months of May and June show that the Wright-Hargreaves recovered $12.69 from each ton of ore treated. The mill is now handling an average of about 130 tons per day.

During the first half of 1921 the mill of the Kirkland Lake treated an average of approximately 125 tons of ore daily. Some difficulties were encountered in getting out the ore, operations having been hampered by a rock-slide, and the average recovery was below normal, being $4.90 per ton. The company has announced a wage reduction of about 15%.

Porcupine.—The enlarging of the McIntyre mill is progressing slowly owing to time required to determine the method best suited to deal with the carbonaceous ores from the lower workings. Some of the machinery is already on the ground.

The Allied Porcupine has now unwatered the shaft and workings of the Three Nations mine down to the 200-ft. level.

Rankin Township.—A staking boom has taken place in this locality, situated about 20 miles north-east from Gowganda, following a discovery of gold by Bernard Micmac, an Indian, who brought out samples which started a rush of prospectors. About 50 claims have been staked. The gold is stated to occur in schist which shows but little quartz, the outcropping formation being about a mile wide from east to west and less than two miles from north to south.

South Lorrain.—High-grade ore has been found at a depth of 330 ft. on the Haileybury Frontier property. The vein is apparently important. The mine was re-opened last year with the object of taking out cobalt ore, but attention has lately been devoted to mining silver.

Developments at the lower levels of the Keeley are encouraging. The stamp-mill is operating on medium-grade ore and turning out concentrates containing approximately 1800 oz. silver per ton.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Augustus Locke was at Boston recently.

Norman C. Stines is here from New York.

William T. MacDonald is at Blackfoot, Idaho.

Abbot A. Hanks has returned from New York.

Howard D. Smith was at Los Angeles last week.

George H. Garrey is geologizing at Telluride, Colorado.

Louis S. Cates has returned to Salt Lake City from Boston.

T. H. Jenks, of Los Angeles, is near Mazatlan, in Sinaloa, Mexico.

James A. Kaney has returned to San Francisco from Kantishna, Alaska.

G. B. Hogenraad has returned to Amsterdam, Holland, from Padang, Sumatra.

W. F. B. Berger has opened an office as consulting engineer at 120 Broadway, New York.

Frederick W. Denton has moved from Painesdale, Michigan, to Cambridge, Massachusetts.

Robert Marsh, Jr., is at Salt Lake City. He returned recently from Alaska and British Columbia.

W. R. Appleby, Dean of the Minnesota School of Mines, has returned to Minneapolis from Manchuria.

Jay A. Carpenter has been appointed Professor of Mining in the South Dakota School of Mines at Rapid City.

O. R. Whitaker has returned to Denver from a four months trip in Mexico, where he has re-opened the old Mapimi mines.

E. W. Bullard has returned from New York. While at St. Louis he officiated as judge in the international mine-rescue contest.

Raymond Brooks it at Musonoi, in the Belgian Congo, as manager for the western mines of the Union Minière du Haut Katanga.

J. R. Elliott, of Pittsburgh, Pennsylvania, president of the Three Kings Mining Co. at Park City, Utah, has been visiting the mine.

Alan M. Bateman, of the Department of Economic Geology of Yale University, has returned to New Haven from professional work in Alaska.

H. C. Gardiner, of the staff of the Anaconda Copper Mining Co. at Butte, spent several days at the International smelter at Tooele recently.

Paul Hilsdale, mining engineer of Salt Lake City and Eureka, Utah, has returned to Utah after a three months trip to islands in the South Pacific.

H. Foster Bain, Director of the U. S. Bureau of Mines, will be tendered a dinner by the local section of the A. I. M. & M. E. on Tuesday, October 4, at the Engineers Club, in San Francisco.

Neal N. Goeglein has resigned as chief assayer to the Chihuahua plant of the American Smelting & Refining Co., and has established an assay office at Chihuahua, where he will represent ore-shippers.

George H. Heath, formerly chief chemist for Calumet & Hecla; **R. R. Seeber**, formerly manager of the Winona mine in the Lake Superior copper district; and **W. C. Polkinghorne**, superintendent of the Ahmeek mill at the time of its suspension, have joined the faculty of the Michigan College of Mines at Houghton.

Charles J. Lavelle, for the past five years in charge of the tabulating department of the Utah Copper Co. at Garfield, Utah, has resigned. He will sail from New York on the 'Carmania' on October 8 for Southampton, on his way to the Belgian Congo to accept a similar position with the Union Minière du Haut Katanga.

THE METAL MARKET

METAL PRICES

San Francisco, September 27

Aluminum-dust, cents per pound	65
Aluminum, sheet, cents per pound	72
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25—12.50
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Zinc, slab, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

September 26.—Copper is inactive but steady. Lead is active and higher. Zinc is in better demand, and advancing.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 20	65.62	39.87	Aug. 15	60.81	37.02
" 21	65.87	40.00	" 22	61.78	38.29
" 22	68.62	41.50	" 29	62.10	38.10
" 23	68.75	41.50	Sept. 5	62.50	38.10
" 24	62.62	41.50	" 12	63.96	38.98
" 25 Sunday			" 19	65.14	39.56
" 26	68.62	41.37	" 26	67.68	40.96

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	126.70	56.08	Sept.	113.92	93.66	....
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.89	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Sept. 20	12.12	Aug. 15	11.75
" 21	12.12	" 22	11.75
" 22	12.12	" 29	11.58
" 23	12.12	Sept. 5	11.72
" 24	12.12	" 12	11.94
" 25 Sunday		" 19	12.08
" 26	12.12	" 26	12.12

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	....
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 20	4.65	Aug. 15	4.40
" 21	4.65	" 22	4.40
" 22	4.65	" 29	4.40
" 23	4.70	Sept. 5	4.44
" 24	4.70	" 12	4.55
" 25 Sunday		" 19	4.60
" 26	4.70	" 26	4.68

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	....
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Sept. 20	4.70	Aug. 15	4.72
" 21	4.70	" 22	4.70
" 22	4.72	" 29	4.65
" 23	4.75	Sept. 5	4.67
" 24	4.75	" 12	4.70
" 25 Sunday		" 19	4.70
" 26	4.75	" 26	4.73

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.62
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	....
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	5.78	....
June	6.91	7.92	4.96	Dec.	8.09	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Aug. 30	47.50	Sept. 13	47.50
Sept. 6	47.50	" 20	47.50
		" 27	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	....
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

MINTS ARE COINING SILVER DOLLARS AT A RECORD RATE

During August the mints of the United States coined 11,870,000 standard silver dollars under the provisions of the Pittman Act, bringing the stock on September 1 to 303,739,326. Since the latter part of February 1921, when coinage of dollars was resumed, there has been minted a total of 33,993,000.

The three mints, at Philadelphia, San Francisco, and Denver, are coining dollars almost exclusively, working 24 hours per day, with three shifts of eight hours each. There is no demand for subsidiary coins at present, in fact money is still flowing back into the Treasury, so the facilities of the Mint service are being devoted to reducing the large stock of silver bullion on hand, purchased under the Pittman Act, which on September 1 amounted to $53,685,229.

Including silver dollars which were melted to provide bullion for subsidiary coinage, a total of 270,121,554 dollars was melted under the Pittman Act. On April 1, 1918, before the melting process began, the stock of standard silver dollars numbered 568,269,513. Deducting from this total the number melted, or 270,121,554, would leave a balance of 298,147,959. On February 1, 1921, when coinage operations were resumed, the stock of silver dollars was down to 269,746,326, which indicates that the stock has been reduced by 28,401,633 dollars, apart from the operations under the Pittman Act. This difference represents silver dollars which were shipped to the Orient at a time when the price of silver was soaring and when it threatened to go beyond the coinage value of subsidiary silver, which is $1.38 plus per ounce. At that time the Treasury, acting in cooperation with the Federal Reserve Board and the Reserve banks, arranged to release silver dollars to be employed in regulating our exchanges with countries having a silver monetary standard.

About 13,000,000 dollars went to the Orient under these arrangements, while, altogether, the silver dollars leaving the country from November 1919 to May 1920 approximated 29,000,000. As these dollars were not melted under the Pittman Act they do not have to be re-coined, so that the silver-dollar stock will be at a less total, even after the operations under the Pittman Act are completed.

The increase in silver dollars since coinage operations were resumed is shown as follows:

	Stock	Increase over preceding month
September 1	303,739,326	11,870,000
August 1	291,869,326	4,647,000
July 1	287,222,326	3,080,000
June 1	284,142,326	7,660,000
May 1	276,482,326	4,370,000
April 1	272,112,326	2,310,000
March 1	269,802,326	56,000
February 1	269,746,326	.....

The Treasury has purchased to date 72,760,430 oz. of silver out of the 208,000,000 oz. to be purchased under the Pittman Act.

MONEY AND EXCHANGE

Foreign quotations on September 27 are as follows:

Sterling, dollars:	Cable	3.74
	Demand	3.74½
Franc, cents:	Cable	7.19
	Demand	7.21
Lira, cents:	Demand	4.16
Mark, cents		0.85

Eastern Metal Market

New York, September 21.

General conditions are changed but little, and while optimism is the rule, heavy buying does not yet materialize.

The copper market continues to be a disappointment with demand very light.

Buying of tin is fairly good from all sources with prices steady.

The lead market is moderately active and strong.

There is still little life to the zinc market.

Antimony is dull and unchanged.

IRON AND STEEL

The steel trade recognizes the good effect of the stir in the wire trade connected with the recent price advance, and on a smaller scale the sheet market has had some notice in the past week, says 'The Iron Age'. Three or four independent companies have announced an advance of $5 per ton. It is not yet clear how far this will be followed. The Steel Corporation has made no change though it is expected to do so, and thus far the chief effect has been to give a few mills more sheet orders at their former prices than they have had in some weeks.

The larger contribution that the lighter products—wire, sheets, and tin plates—are making to current mill-operations is emphasized by a further slight increase in total steel output, as expressed in ingots, at the same time that the heavier products—rails, plates, structural shapes, and bars—show on the whole no increase.

A gradual increase in the buying of steel, even though actual consumption may not change in any marked degree, is a common expectation for the autumn months, but buying for forward delivery is not looked for until 1922. Meanwhile there is a definite effort by steel manufacturers to limit their losses on current business.

Structural steel lettings, which at times seem to be increasing, are shown to have been fairly uniform for six months ending with August. The August total was 59,300 tons, or about one-third of a month's fabricating capacity, while the six months' average was 57,550 tons.

Exports of iron and steel for August are estimated at 73,792 tons, apart from several unimportant items unreported. This is the lowest tonnage since January 1909, and compares with 86,523 tons in July 1919 and 431,484 tons in August 1920.

ANTIMONY

The market is featureless with quotations nominal at 4.45c. per pound, duty paid, New York, for wholesale lots for early delivery. Jobbing lots are quoted at 4.65 to 4.90c.

ALUMINUM

Virgin metal, 98 to 99% pure, is unchanged at 24.50c., f.o.b. plant, from the leading producer, with the same grade available from importers at 19 to 20c., New York.

COPPER

Disappointment as to buying power or demand continues the feature of this market. Prices are not weak and are firmer if anything. Consumers, however, continue to refrain from buying, believing that the present advance has been overdone and that they can buy at less prices later. Electrolytic copper is quoted by those willing to quote, at 12.12½c., New York, or 12.37½c., delivered, but these prices are largely nominal. It is said that 12.25c., delivered, could be done but there has been no actual test of the market. Several large sellers continue out of the market. It is generally the opinion that all the cheap copper has been eliminated permanently, or at least so far as the near future is concerned, and hence the stiffer conditions of prices. Foreign buying is dominated by the Far East, but it is not large in the aggregate, due to exchange conditions.

LEAD

There is more strength in the lead market than in any other. Buying is active and prices continue to advance. Late yesterday the American Smelting & Refining Co. added more points to its prices, bringing it to 4.65c., New York and St. Louis. A feature of the market is buying from consumers who have not been heard from in a long period. The outside market is strong at 4.65c., New York, and 4.45c., St. Louis, but not much selling is reported by independents in the market, the demand being apparently satisfied by the leading interest.

TIN

Moderately active buying of Straits tin continues a feature of the market. Last week Wednesday about 200 tons of futures was sold at 26.50 to 26.62½c. and on the following day probably 200 to 300 tons was sold at 26.37½ to 26.50c., purchased nearly equally by consumers and dealers. On Friday there were light sales of futures at 26.25c. and the same is true of Monday of this week when October-November shipment from the East sold at 26.37½c. with 26.50c. bid at the close. It is reported that consuming inquiry has been good most of the time. Spot Straits tin was quoted yesterday at 26.50c., New York, while the London market values were about £1 per ton lower than a week ago at £155 10s. for spot standard, £157 15s. for future standard, and £156 5s. for spot Straits. Arrivals thus far this month have been 2225 tons with 3050 tons reported afloat. American pure tin is quoted at 26.12½c. with 99% pure tin at 25.87½c.

ZINC

This market is a little weaker than it was a week ago with prime Western sold down to 4.17½c., St. Louis, in the last week and with unconfirmed rumors that 4.15c. has been done. Inquiry is not active and the greater activity in the steel market, particularly in sheets, has not had its effect yet on zinc. There is a little business being done each day but most producers are not active sellers. We quote the market at 4.17½c., St. Louis, or 4.62½c., New York, for wholesale lots for early or 30-day delivery.

ORES

Tungsten: The market remains lifeless and featureless with values nominally unchanged at $3 and upward per unit in regular 60% concentrates, depending on the quantity, grade, and delivery.

Ferro-tungsten is inactive and nominal at prevailing prices.

Molybdenum: There is no demand and prices are nominal at 50 to 60c. per pound of MoS_2 in regular concentrates.

Manganese: Demand has completely vanished and quotations are nominal at 20 to 22.50c. per unit, seaboard.

Manganese-Iron Alloys: The market is much more active and more sales have been made than in many weeks. At least 1000 tons of British and American ferro-manganese has been sold on a basis of about $58.35, seaboard, for both alloys, the new price announced a week ago. Inquiry is also better, one being for 125 tons for early shipment. Spiegeleisen is inactive and unchanged at $25 to $26 for the 20% alloy.

Demand for 50% ferro-silicon is light at $60 to $65 per ton, delivered.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.25 to 1.50
" " " " carboys "	2.25 to 2.75
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	7.75 to 8.75
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.25 to 6.00
" powdered, in barrels "	5.50 to 6.50
" glass, ground, 30 mesh, cases, tin lined, per 100 lb	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	0.31
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per ton	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO_2, – ¾ % Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.16½
" " " " granular " "	0.16½
" " " " powdered " "	0.17½
" carbonate, calcined, in barrel lots, per lb	0.25
" permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.00 to 3.50
" bicarbonate of " "	3.00 to 3.50
" caustic, ground, 98% " "	6.50
" " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	11.05
" " " 2-in. "	34.80
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.70
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	19.50
" " " 14, single-braid, rubber-covered " per 1000 ft.	6.80
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.20
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	25.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb	9.00

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.00
" gelatine " " "	19.00
" ammonia " " "	18.00
Fuse, common, in case lots, per 1000 ft	8.50
" waterproof, triple tape, in case lots, per 1000 ft	10.54

FUELS

Coal, Utah steam, $4 at mine, plus $7.50 freight to California terminal points, in carload lots, per ton	11.50
Coal, blacksmith's, in carload lots, per ton	24.00
" " in small lots, per ton	27.00
Coke, in carload lots, per ton	26.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate " "	0.16½
Gasoline " "	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine "	0.42½
Brass sheets, half-hard and soft, per pound	0.28
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅜ by 2-in., per 100 lb	8.75
Nails and spikes (20d to 60d base), per keg	4.90
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	10.10
" cold punched " "	11.90
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, per 100 lb	5.50

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.75
Rails, steel, 8 to 25-lb., per 100 lb	3.99
Reinforcing-steel, per 100 lb	3.75
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.55
" flat " " " "	6.45
" flat, black iron " "	5.90
Structural T's, channels, angles, and beams "	3.85
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	6.75
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	13.30
" " galvanized " " "	16.70
" " black " 4-in. "	58.00
" " " extra strong " "	113.75
Shafting, cold-rolled (2¼ to 3-in. base) "	5.50

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
" " extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	80.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M	200.00
White pine " " " "	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb. cans, per can	7.75
Cotton waste, best grade, per 100 lb	14 00
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.16
" " " 2 (standard), per pound	0.15
Packing, flax, per pound	0.33 to 0.85
" sheet "	0.25 to 1.00
" steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	35 00
Tube-mill pebbles, Danish, selected (in bags), per long ton	30.00
Zinc-dust, in 250-lb. boxes, per 100 lb	8.25
" sheet, 36 in. by 84 in., No. 9 gauge, in ton lots, per 100 lb	14.85

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots	60.75
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	3.25
Portland cement, in bags, per barrel of 380 lb	3.95
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	4.55
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	12
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 7c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound	1 to 9
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump, white, per ton	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn	5
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

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T. A. RICKARD, • • • • Editor

AMONG the few gold-mining regions that are showing a steady increase in production of the precious metal is Southern Rhodesia. The output for July was 51,564 ounces, as compared with 49,466 ounces in June, and with 42,208 ounces in July of last year. Southern Rhodesia is essentially a country of the small-mine owner, whose methods of mining and milling are often sounder, more economical, and more efficient, despite small tonnage and limited capital, than those adopted by the officials of many big corporations.

THE Supreme Court of Nevada has held that failure to file notices of intention to take advantage of the joint resolution of Congress waiving the requirement of annual assessment work does not necessarily impair the rights of claim-holders. Even though the terms of the resolution are mandatory, the construction of the Nevada Court is that a showing of good faith and an open, honest effort to comply with the statute may serve to preserve the right of the owner, even in the absence of formal filing. Although this decision theoretically might work a hardship on some adverse claimants, we are of the opinion that in reality few, if any, re-locations have been made by men who were not aware of the intention of the original holder to comply with the terms of the Act.

INCALCULABLE are the vagaries of human nature. First we were told—and we believed it—that in order to restore normal conditions we must be thrifty, we must work, we must be productive. Now, apparently, the pendulum of opinion has swung, so wildly as to seem drunken, to the other extreme; for "a conference of New York's leading business men has been called to further the movement for a 'buyers week', with the idea of selling a $100,000,000 worth of merchandise in two weeks, thus starting a flow of goods from factory to consumer, giving relief to the economic pressure and aiding unemployment". Was ever a bigger bit of impudence perpetrated upon a weary public? The dry-goods merchants who desire to start an orgy of spending under cover of "relief to the economic pressure" are sardonic humorists —and impudent fakers.

DISCUSSION this week starts with an interesting letter on the subject of the proposed new mining law from Mr. Robert B. Brinsmade, who is now in Mexico. He submits a thoughtful criticism, based on his experience not only in the United States but in the country in which he is sojourning. He is a radical in his views of our social system and speaks plainly concerning such of its anomalies as bear upon the mining industry. Mr. Algernon Del Mar contributes several useful notes on the application of flotation to the concentration of precious metals. He quotes from experience and offers sundry data based upon the operation of two mills. Mr. A. C. Halferdahl writes on surface-tension in flotation, apropos of Mr. Fahrenwald's recent article. Our friend Mr. Warren D. Smith, now Chief of the Division of Mines in the Philippines, writes to correct a statement, appearing in a consular report and re-printed in a recent issue of the 'Press', concerning the silver-ore resources of the Islands.

DAMAGES from the Brotherhood of Railway Trainmen are being claimed by a switchman who is the plaintiff in a suit that has been filed in the District Court at Chattanooga, Tennessee, to recover $5000. The switchman claims that the Southern Railway was forced by the Brotherhood to dispense with his services. The case is of interest, for if the members of such an organization demand the dismissal of an employee who is not one of them, and if the organization can be sued for damages, then it would appear that the recognition of the principle of the 'open shop' is inevitable. In the present case the Brotherhood has filed a plea in abatement, affirming that it is merely a voluntary association, with no officer or agent in the State of Tennessee upon whom the process can be served. The local court, it maintains, is without jurisdiction in this instance. This would appear to us to constitute a legal quibble. We trust that the discharged switchman will be awarded damages in compensation for the deprivation of his right to work, and because of the interference, by a labor organization, with a fundamental privilege of a citizen of this country.

IN the 'Los Angeles Daily Times' we read of a local dentist having discovered—near Santa Monica—a deposit "said by some metallurgists to be rock containing refractory carbon". This deposit is said to constitute "high-grade gold ore". To recover the gold, it is necessary—we are told—"to bake or roast the shale or rock deposit at a high temperature to burn out the carbon", that is, the "refractory" carbon. Several high assays

are quoted, but it is admitted that "no efforts have been made to ascertain accurately the percentage of gold content that can be recovered by a commercial process". We venture to say that no effort has been made to write intelligently, to obtain trustworthy data, or to make any reasonable inquiry into this silly tale. The abysmal ignorance and lack of education illustrated by the matter and manner of this piece of writing serve to indicate the kind of foolish persons that work on the daily press. Among the citizens of Los Angeles are many capable mining engineers; indeed, some of them are men of world-wide experience and knowledge. Why does the staff of the 'Times' forego the opportunity of obtaining reliable information and of saving itself from well-deserved ridicule?

AN interesting side-light on 'unemployment' statistics may be found in the experience of a reporter in Denver, who in the course of one morning obtained seven prospective jobs at manual labor, while during the same period he was refused work for various reasons by only six other employers to whom he applied. Government estimates place the number of unemployed in Denver at 8000. According to the article in the 'Rocky Mountain News' the reporter told no tales of a sick wife and starving children; he had no story of service in France as a soldier fighting for his country; he made no effort to play upon the sympathies of the prospective employer, but merely asked for a job on the ground that he was well and strong and willing to do hard work. He dressed himself in workingman's clothes and only revealed his identity after having been hired to go to work the next morning at a wage of $4 or more per day. Even in these times a man can live on $4 per day. There are, of course, men who are not physically able to work with pick and shovel or to truck heavy freight at a railroad depot, but we wonder if much unemployment is not the direct result of receiving high wages during the War, and 'getting by' with as little work as possible in return. Suppose that every man who was physically able would take the best job that was offered at a living wage. Would it hasten the return of prosperity and thereby enable him to get back his old job at better pay? Prominent labor leaders, employers, and capitalists in conference with Mr. Hoover at Washington will help; but the real solution of unemployment may be a radical change in the attitude of every individual who must work for his living.

TELLURIDE minerals have been found in an orebody cut recently in a mine on the Comstock lode. This is interesting, chiefly because it raises a difficulty, by no means serious, in the metallurgical treatment of the ore. The discovery is described in the daily press as a "tellurium ore strike"; the find itself is said to be "the largest body of tellurium ore ever found in Nevada", and "the finding of this metal in such an orebody is of unusual significance", because "tellurium is usually associated with high-grade gold ore". It is truly remarkable how much misinformation can be conveyed by an ignorant scribbler. In the first place, he means that telluride ore, not tellurium, has been found. The element tellurium has been found in the mines of Colorado and Transylvania. It is an element—not a metal—of slight value, its principal use being as a violet pigment in the making of stained-glass windows. The tellurides, or compounds of tellurium with the metals, are of much greater economic importance, especially to the miner. The report quoted above must refer to the finding of ore containing the telluride of gold, namely, calaverite, which owes its name to the county of Calaveras, in California, from which came the specimen that the chemist F. A. Genth used to determine this mineral species. As to "the largest body of tellurium ever found in Nevada", we recall the fact that ore rich in the tellurides of gold and silver was exploited in 1907 in the Combination mine, which later became a part of the Goldfield Consolidated, at Goldfield, Nevada. As to the significance of finding a telluride in a gold ore, we venture to say that it is no more significant than the finding of native gold, for veins that carry gold as a telluride are not necessarily richer that those that contain gold in pyrite or in quartz. The characteristic is qualitative, not quantitative. The idea that "tellurium is usually associated with high-grade ore" is opposed to experience in many parts of the world, notably Transylvania, Cripple Creek, and Kalgoorlie, in all of which districts there are veins of low-grade as well as of high-grade telluride ore. It was thought at one time, by newspaper writers and other careless persons, that the presence of a telluride mineral in an ore was a sign of persistence in depth. At Kalgoorlie this fallacy was rampant during the boom of 1897; it was advocated by a pseudo-scientific gentleman named Maryanski, whose sobriquet, "Mary Ann", fitted him admirably. We hope our friends on the Comstock will find plenty of gold, preferably in the native state, readily amenable to cyanidation, without roasting.

South American Affairs

International disputes are generally of so complicated a character and so involved with domestic matters that it is usually inadvisable for the nationals of other countries to proffer advice or to act as arbitrators. Much harm has ensued from the outbursts of irresponsible journalists and editors in this country who occasionally discuss South American affairs, and whose viewpoint seldom is based on reliable information or on a first-hand knowledge of the facts. It will be a matter for regret, both here and in Latin America, that our contemporary in New York has attempted to discuss and to pass judgment on what is known as the Tacna-Arica controversy; for it is evident that the writer of the editorial on the subject that appears in a recent issue of the 'Journal' is ignorant of the facts. This territory, we are told, "before the war between Bolivia, Peru, and Chile, was considered Peruvian, but was held of little value, and after the war it was turned over to Chile for 10 years, with the agreement that at the end of that

period a plebescite, or vote of the population, should determine whether it should thenceforth be Chilean or Peruvian". The war, which by the way was one in which Chile fought the combined forces of Peru and Bolivia, resulted in the complete defeat of the allies. Tacna and Arica, together with the provinces to the south that belonged formerly to Peru and Bolivia, were won by force of arms. The writer then discusses what he terms the "unsatisfactoriness" that "developed in the plan for the disposal of Tacna-Arica. Valuable nitrates were discovered in the province and copper mines were opened; . . . but in the meantime Chile had already apparently disposed of her possible ownership by agreeing that if she obtained, by the plebescite, possession of Tacna-Arica, she would sell it to Bolivia so that that landlocked country might have an outlet to the Pacific through the port of Arica. Mark, then," continues our contemporary, "how the discovery of valuable minerals changed all this. Chile becomes reluctant to give up that possession which is nine points of the law, and quite rivals the later example of the Supreme Council in the Upper Silesian matter in her failure to carry out a definite plebescite". This account of the Tacna-Arica controversy lacks evidence of familiarity with South American affairs. The treaty between Chile and Bolivia in regard to an outlet on the coast was never ratified; Chile, however, is still willing to help Bolivia in a spirit that is seldom shown to a defeated nation. Her integrity cannot be impugned on the ground that a change of attitude has resulted because of the discovery of valuable minerals; the commercial nitrate deposits and the larger copper mines are far to the south. Nitrate, the more important, was discovered early in the 19th century; the industry was later exploited, developed, and financed by Chileans in the Province of Tarapacá; in the Departments of Tocopilla, Antofagasta, and Taltal, in the Province of Antofagasta; and at Aguas Blancas, a district in the Province of Antofagasta. Tacna is, primarily, a buffer province, of little material value and of considerable expense to Chile. Had the writer of the editorial in question examined the available documents he would have been less likely to blame Chile for the failure to carry out the plebescite at the arranged date. Few of our South American friends are guiltless of spreading propaganda in this country in favor of this or that phase of international dispute; in many cases they are obliged to do so in order to combat misinformation. Everyone is entitled to an expression of opinion. We ourselves were taken to task lately, in a letter that we were asked not to publish; but, as the editorial note that was criticized was based on actual experience, personal contact, and first-hand information, we still venture to think that the comments and conclusions merited publication and thoughtful consideration. It is the duty as well as the privilege of an editor to attempt to mold public opinion. In regard to the discussion of the Tacna-Arica controversy, however, there is a tendency to overlook the undisputed fact that the nitrate deposits had been exploited by Chileans for many years before the War of the Pacific; that conflict arose because of an alleged unfairness on the part of Bolivia, the ally of Peru, toward Chileans, particularly toward the Compañia de Salitres y Ferrocarril de Antofagasta, a Chilean corporation. Similar circumstances, few of which have led to war, have marked the history of other countries in which, for reasons that need not be discussed, the nationals have failed to exploit their own resources. Further, the development of Chilean copper mines during recent years has occurred in territory the ultimate ownership of which cannot be called into question. The League of Nations has no more right to return the Province of Antofagasta to Bolivia than to give to Great Britain the political control of Massachusetts. The copper mines in the Province of Tacna are of negligible importance; there is little indication of workable nitrate deposits there.

Lead-Poisoning

The Treaty of Peace that was signed at Versailles provided for the holding of international conferences on questions in which labor has a vital interest. These conferences are attended by representatives of the governments, of the employers, and of the workers; and each country is under an obligation to carry out, so far as practicable, the decision. The International Labor Office will hold a conference at Geneva this month, under the auspices of the League of Nations, at which proposals will be made to prohibit the use of lead in paints. It is estimated that 85% of the white-lead produced is used in such manufacture, so that the loss to the lead industry would be serious if such a proposal were to be endorsed and enforced. It is unfortunate that labor leaders so often refuse to consider the facts relating to a question, or to accept a scientific explanation of a happening. The lead in paint has been blamed for all the troubles and ailments that afflict the workers in the painting trade; but, as Mr. Stephen Miall pointed out at a meeting of the Society of Chemical Industry in Liverpool recently, the abolition of lead and the substitution of other heavy-mineral derivatives may result only in an aggravation of the trouble. Zinc oxide, one of the proposed substitutes, is not equal to white-lead either in durability or in 'hiding' power; further, it is known to be a general protoplasmic poison, causing muscular paralysis and kidney disease. Many of the ailments that afflict those in the painting trade are due to the turpentine in the paint and not to the lead; in other instances it has been shown that disease results from carelessness. Thus the 'rubbing down' of old lead paint with sand-paper or pumice-stone produces a poisonous dust that may be inhaled by the worker; this practice, as suggested by Mr. Miall, should be prohibited by law; the sand-paper should be moistened with a cheap mineral oil; under such conditions it lasts as long as if used dry, and the results are equally good. Again, painters should never handle dry white-lead or other metallic pigment; these should be supplied in an oil medium. Lead-poisoning is, to a large extent, preventable; this fact is proved easily by statistics. The

number of cases of poisoning in the British white-lead industry was reduced from 399 in 1899 to 189 in 1901, 40 in 1915, 18 in 1916, and none in 1918. These results were obtained after a realization of the fact that "all risk lies in inhalation of dust and fumes. These removed and prevented, there will be no lead-poisoning".

At the first of the conferences of the International Labor Office, held at Washington a few years ago, it was recommended that in view of the complexity of industrial diseases the problems involved should be considered carefully beforehand by a committee, with representatives of the governments, of the employers, and of the workers. No such committee has been appointed; the problems of lead-poisoning are being considered only from the biased viewpoint of the Labor Office. The least that should be expected is that such questions will be discussed with all due regard to scientific fact and historical accuracy. A vigorous propaganda was started in England in the early days of the present century for the abolition of the use of lead in the pottery industry. Instead, the problem was solved by research, followed by the application of the principles of common sense and hygiene; lead-poisoning has been abolished in that industry. We agree with Mr. Miall when he says that "the International Labor Office may be productive of much good, but in so far as industrial hygiene is concerned it will accomplish nothing without the co-operation of those primarily affected; its present methods are tending to promote suspicion rather than confidence".

Minerals Separation v. Butte & Superior

Litigation over the Minerals Separation patent is proceeding in the usual leisurely way. The latest decision in the Butte & Superior case appears to have been misunderstood in some quarters. Several months ago the patent-exploiting company filed a motion in the U. S. District Court of Montana asking that the Master, to whom the case has been referred for an accounting, be instructed to consider only such standards of comparison as were open and available to the defendant at the time (1905) of the invention that is the subject of the suit. This question of a standard arose from the need to estimate the amount of "gains, profits, and advantages" due to the plaintiffs by reason of the adjudged acts of infringement. The plaintiffs, Minerals Separation Limited *et al.*, desired to restrict the defendant, the Butte & Superior Mining Company, to water-gravity concentration as practised in 1905, and thereby to exclude, as a standard of comparison, the '1% +' oil methods that were held by the U. S. Supreme Court to be non-infringing. The defendant, in his brief, contended that the law was well settled, that the infringer was not restricted to such processes as were open at the date of invention, but was allowed to 'set up', as standards of comparison, all such processes as were open for use at the date of infringement. It was further contended, on the same side, that the logical extension of this rule permitted a 'day to day' standard; that is to say, for each day's infringement the defendant was entitled to fall back upon the current art as it had been developed on that day. This interpretation seems to have had the endorsement of the Supreme Court in several previous cases, that is, it was upheld that the infringer is not restricted to the processes known at the date of the invention, but no authority existed for the 'day to day' rule until Judge Bourquin of the Montana court, in this flotation case, adopted it. In his recent opinion, Judge Bourquin instructed the Master to keep in mind the rule that the standard to be adopted by him in his accounting shall be "any standard that may be duly made to appear in respect to subsequent infringement". This permits the defendant to set up the current art from day to day throughout the period of infringement. The defendant may, for example, set up the 'A' process as that which was open and available to him at the beginning of his infringement, say, in 1911. He may apply this standard until the 'B' process is developed, say, in 1913, which 'B' process he may apply as his standard of comparison until, say, 1915, when he may set up the 'C' standard, which meanwhile has been developed in the art; or he may adopt any one or any combination of these processes for his comparison subsequent to the date at which the process was developed. There is no room for doubt as to the correct interpretation of this opinion. The effect of the decision may prove far-reaching. In the present case it will enable the defendant to fall back upon gravity concentration, '1% +' oil-flotation, and the electrolytic deposition of zinc. The result may be to show such small "gains, profits, and advantages" due from the defendant to the plaintiffs as to make it advisable for the plaintiffs to elect to take damages instead. If they should do so, they would have to show that there is an established royalty for the use of the patent covered by the patent in suit, or, in the absence of an established royalty, they would have to set up a 'reasonable' royalty. This will provoke a smile among many of our readers, for the license agreements of Minerals Separation cover the use of more than 60 patents; the royalties vary greatly, because many of them are based on the principle of 'all that the traffic will bear'. By the same token, it will be difficult to establish the reasonableness of these royalties. If the plaintiffs should be driven to make a claim for damages, we shall be curious to see how they will apportion the license fee as between the several patents set forth in the license agreements. For example, the patent in suit (No. 835,120) expires in 1923, but there is a suit pending against Butte & Superior in which that company is charged with infringing a patent, No. 962,678, on a so-called soluble frothing agent by the very acts that in the first suit are charged to have infringed No. 835,120, the froth-agitation patent. Judge Bourquin's decision may affect other cases also, namely, those pending against the Miami, Nevada Consolidated, and Magma companies. It looks as if Minerals Separation will be able to collect no more than royalties as damages, and in proving the reasonableness of such royalties and the apportionment of them between the several patents they are beset with several pitfalls.

Charcoal and Cyanidation

The granting of a United States patent to Messrs. K. Byron Moore and H. R. Edmands for a special use of charcoal in the precipitation of gold from auro-cyanide solution draws attention to one of the most interesting developments in the history of the process. So far as can be ascertained, lump charcoal was first used in this connection in Victoria, Australia, and soon after the introduction of the MacArthur-Forrest invention; it was crushed in rolls, then screened and washed to remove the fine dust. Small precipitation vats were used, each of which was provided with an earthenware pipe, placed to stand in the centre of the vat, and filled with charcoal. The tubs were arranged in rows, and at different levels, so that gravity flow of solution from tub to tub was practicable. The liquor passed down through the central pipe in each tub, and upward through the mass of the charcoal, thence to the tub below. At intervals of twenty-four hours the top tubs were removed, the other receptacles being moved up into place, and tubs with fresh charcoal placed at the foot of the series. The spent charcoal was burned in a furnace, and the ash was smelted to recover the gold. The process was never adopted on an extensive scale; a large volume of charcoal was needed for a small plant, one treating 84 tons of solution per day was reported to require 198 tubs, each about two feet in diameter by about two feet high. Labor requirements were excessive; precipitation was inefficient, particularly unless fresh charcoal was substituted for the spent material at frequent intervals. The ash was easy to smelt, but it was bulky; the final recovery of the gold, therefore, was a costly operation. The more expensive zinc-shaving was considered cheaper in the long run, and was adopted universally as a precipitant. In a few instances charcoal has been utilized to save small amounts of gold that would otherwise have been lost and that may be found in the decanted solution from slime-tailing dams or in mines where the seepage from tailing-filled stopes contains a minute proportion of dissolved metal. The total amount of gold thus recovered, however, was and is negligible. Influential interests encouraged the use of zinc; there was no influential interest to favor the use of charcoal. No attempt was made to improve the technical methods of the 'precipitation' of gold by charcoal during two decades; when an improvement was made, it was the consequence of war-time economy.

For a long time the reason for the abstraction of gold from a cyanide solution by charcoal was a mystery, and a mystery in which few were interested. This was largely due to the fact that the result was always considered as one of precipitation by chemical action; no alternative explanation or suggestion was entertained. In 1913 an elaborate series of experiments was undertaken by a student in South Africa, who decided that the phenomenon—for it was a phenomenon at that time—was due to the action of the carbon monoxide gas that was occluded in the pores of the charcoal, a substance that, *per se*, could not, according to the laws of electro-chemical action, precipitate gold or silver. Carbon monoxide gas also has no action on an ordinary auro-cyanide solution; but this objection was met cleverly by the assumption that the gas occurred in a condensed and active state in the pores of the charcoal, and was therefore different from the carbon monoxide of ordinary pressures. The negative result obtained by a comparison of the precipitating powers of charcoal before and after the abstraction of the carbon monoxide at low vacuum and normal temperature was explained by the contention that the loosely-held gas was valueless as a precipitant. The carbon monoxide theory received universal support. Additional and confirmatory hypotheses were advanced from time to time, some of which suggested that the result of the chemical action that was alleged to occur was a carbonyl auro-cyanide, of varying analysis.

In 1915 it was suggested in the transactions of the Institution of Mining & Metallurgy, after an independent research on the subject of the physical influences of surface concentration and absorption, that the adsorptive effect of colloidal carbon when in contact with goldbearing cyanide solution might well form the basis of research. This suggestion arose from a disinclination to credit chemical action with any share in the result of the so-called precipitation of gold by charcoal. In 1916 or 1917 the first intelligent step seems to have been taken on a practical scale to use charcoal efficiently, and by the engineers whose names appear in the first paragraph of this résumé. Laboratory experiments indicated that fine charcoal was a much more effective 'precipitant' than the lump charcoal previously used. The inventors, in spite of the scientific significance of such a fact, still clung to the carbon monoxide theory, even when it was found that water-quenched and wet-crushed charcoal was twenty times more efficient than air-dried dry-crushed charcoal. In another quarter it was suggested that the quenching and crushing in water removed the occluded gases, to a great extent if not entirely; 'precipitation' was more efficient under such circumstances, so that it seemed reasonable to assume that carbon monoxide had nothing to do with the reaction; it was suggested that the abstraction of gold was entirely due to the adsorption of the auro-cyanide compound in the solution, and this theory received additional support from the fact that the efficiency of 'precipitation' was found to be directly proportional to the amount of surface exposed by the charcoal. By using solutions of graduated gold content, the abstraction of the metal was found to obey the laws of adsorption. Fine grinding was an essential to success. The action was physical and not chemical; the problem could have been solved in a few weeks by a physical chemist; but, strange to relate, the average cyanide metallurgist thinks little of physics in connection with the changes that occur in treating ores and recovering metals. His confrere, the flotation specialist, appreciates the distinction between physical and chemical action, and realizes the importance of surface-tension and surficial concentration; but the cyanide metallurgist usually prefers to argue almost entirely from the chemical point of view.

Physical effects such as adsorption and capillarity are uncanny and, to a certain extent, inexplicable; consequently, no advantage has been taken of the work of contemporary scientists in an attempt to explain the adsorptive nature of charcoal as a 'precipitant' of precious metals. Researches on the relative effects of various types of wood-charcoal on a solution of mercuric cyanide were made in Europe recently; the physical chemist in charge of this work would have smiled a smile of incredulity if it were suggested that the mercury was being precipitated by carbon monoxide or other gas. And yet, had physics instead of chemistry been applied to the problem that confronted the cyanide engineers in the early days of the industry, and if charcoal in various physical forms, fine and coarse, had been tried, many economics might have ensued.

The new Moore-Edmands process has been tested on a commercial scale in Western Australia and, it is understood, in Africa. The scope of the new 'precipitant' and the practicability of its comprehensive application have yet to be determined. Nevertheless, convincing empirical results have been obtained, all the more interesting because the patentees apparently failed to appreciate the scientific or theoretical significance of their discovery. An exceedingly clean and finely ground adsorbent is essential to maximum 'precipitation'; this is obtained by allowing the red-hot charcoal to drop through the grate-bars of a producer-gas plant and into water; it is then pulverized in a ball-mill. The emulsion is mixed with the auro-cyanide solution, and cakes of the charcoal are formed in a miniature Butters filter; after a definite period these are discharged, re-pulped, and re-formed on the leaves by the application of vacuum. The extractors are operated in series; the one in which the cakes are approaching saturation receive the richest liquor, the tailing solution going to the second extractor being finally impoverished by contact with fresh charcoal. The final cake, loaded with gold, is filter-pressed, dried, and smelted in the ordinary way. A tilting furnace, which provides large capacity, has been found to be suitable for the purpose.

The gold industry needs encouragement. Any suggestions toward cheapening the cost of cyanidation should be welcomed. The new process offers possibilities in this direction by the utilization of charcoal, which is obtainable almost anywhere and at a negligible cost. A realization of the theory of the underlying reaction of such 'precipitation' will help to minimize losses in those cases where charcoal is found in the ore and stope-filling going to the mill; for it is evident that every precaution should be taken to avoid the reduction in size of such material when it cannot be used as a precipitant, and when 'precipitation' means loss. The use of zinc in the operation of the cyanide process has always been accompanied by disadvantages, for soluble double-cyanides are formed. These are of little or no value as solvents of the precious metals; they accumulate, to the detriment of efficient extraction of the gold in the dissolving stage and of efficient precipitation in the zinc-box or press. Various alternatives have been suggested. Thus, in a recent article in the technical press, it was shown, in a slime plant where excessive dilution of the pulp was practised and where much solution had to be discarded, that the precipitation of the gold in the zinc-boxes was exceptionally good. In another part of the plant, where the zinc accumulated in the solution to an undesirable extent, a drip of strong cyanide was needed to raise the amount of free cyanide in the liquor entering the boxes; the necessity arose because of an accumulation of zinc in the solution; the cyanide was there as the double salt; it was not available for precipitating purposes. The remedy increased the trouble, and resulted in a further loss of both solvent and precipitant, for zinc is readily soluble in cyanide. Excess cyanide is not needed when charcoal is used; in fact, a prominent characteristic of adsorption is that "the amount of dissolved substance taken up by the solid increases much more slowly than the concentration of the solution; the removal of the substance is relatively more complete in dilute solutions". Thus with a solution containing 2.16 milligrammes of gold in 200 cubic centimetres of solution it was shown that 96% of the metal was adsorbed; with a solution of ten times that strength, and by using the same amount of charcoal, only about 50% was adsorbed. Similarly it was found that, after a ten-fold increase in concentration of an aqueous solution of acetic acid, the adsorptive capacity of charcoal was not even doubled. A few experiments would prove whether or not the silver present in a cyanide solution resulting from the treatment of an average gold-silver ore was in such quantity that efficient 'precipitation' with charcoal could only result after dilution or by repeated treatments; it is suggested that the good results obtained in the case of auro-cyanide solution may be due to the comparatively low concentration of the metal.

When aluminum was introduced as a substitute for zinc in normal cyaniding operations it was hoped that its use would become general, for no deleterious compounds are formed in the solution. But, unfortunately, other troubles arose, which indicated that the disadvantages more than countered the advantages. At the New York & Honduras company's mill in Honduras, for example, it has been found that the maximum capacity of the plant is reduced by 1000 tons per month when aluminum is used, because the addition of sufficient lime to ensure coagulation and settlement of the slime is impracticable, and, under such conditions, the thickeners function at a seriously reduced capacity. The incrustation of the equipment also causes much trouble and expense when aluminum is used as a precipitant. The improvements resulting from the adoption of the practice of de-aerating the solution before precipitation by zinc (the Crowe process) are such that considerable reductions in the consumption of precipitant and solvent have been reported. The adoption of charcoal, if its use could be demonstrated as practicable, would obviate all difficulties arising from fouling of solution or incrustation of equipment; for the action is a physical one, and no deleterious compounds are formed.

Revision of the Mining Law

The Editor:

Sir—The law as drafted appears to be the result of long and careful study on the part of its projectors; nevertheless it seems vulnerable to criticism on both its theoretical and practical sides, as I shall now endeavor to show.

In theory it has failed to lay a democratic foundation for the future expansion of the mining industry: first, by allowing freehold tenure; and second, by the union of subsoil and surface rights. These two errors are responsible for the widespread speculation and monopoly now existing in the mineral lands of the Eastern States, and—coupled with the lax enforcement of compulsory work for unpatented claims—account for the same conditions in the West. A similar result was produced by the Mexican mining code of 1892, which abolished the ancient requirement of continuous work and substituted for it a trifling annual tax on the area held. By 1905 this change of policy had already produced the following unhappy results, according to Licenciado Miguel Mejia*:

"The mine-owners found it convenient to pay the tiny areal tax and then to shut-down, sometimes for want of working funds but oftener owing to bad faith on the part of the directorate, which wished to depreciate the company's shares in order that they might acquire them cheaply from the small stockholders. Some were even cleverer, for they monopolized whole mining districts by new denouncements and kept them unproductive, so that none of the old mines could be worked or any explorations made for new ones. What resulted from this new order of things? The mines stopped their payrolls and the half-starved miners were driven into exile, thereby ruining the merchants and a multitude of other people who depended on the mines. Families began to emigrate, and houses became vacant; the local governments could not be sustained, and whole towns were ruined. Even the Federal government found that it lost more from this decrease in local taxation than it gained by the new mining tax. Such have been the disastrous effects of this law, which deprived the nation of its former free access to its mineral deposits and permitted them to be monopolized and held idle indefinitely."

In 1910, at the beginning of the Revolution, this condition became worse, for there existed hardly a mineral outcrop that had not been covered by a denouncement. But legislation since 1914 has corrected this evil by the simple device of so increasing the areal tax as to make land speculation unprofitable. For those exceptionally rich districts in which the areal tax alone would be insufficient to prevent forestalling, the Mexican law permits obligatory work to be prescribed. In consequence of these changes the bulk of the former monopolized areas are now open for denouncement, and it may be said truly that Mexico now offers a better field for the prospector and small operator than any other country in the world.

From the experience of Mexico it is thus safe to conclude that any measure that encourages the idle holding of mineral land is a bad thing for the community, whether the result of too low an areal tax, as prevailed there between 1892 and 1914, or because of the turning of a leasehold into a freehold title, as is done by the United States provision concerning the patenting of claims. A patented claim could be taxed as much as an unpatented one, but the patenting removes the ground from the jurisdiction of the Federal into that of the local government, which, in few cases, has any provisions in its tax code that have been designed to prevent speculation in mineral land. Therefore, I can see no object in requiring that all claims be patented within seven years, as is proposed in the new law; indeed, it would seem wiser at least to continue leasehold titles in every State that had failed to bring its tax or work requirements for mineral land up to the minimum prescribed by the Federal code†. This would be following the mining experience of Australia, where freehold titles have generally been replaced by leaseholds.

Even more important than the retention of the leasehold title is the question of the separation of subsoil from surface rights. This the new law should have introduced when it dropped the existing provision for apex rights. The first important modern code to embody the principle of subsoil rights as a separate property from the surface was that of Carlos III, which was applied in 1783 throughout the Spanish dominions. It assumed the subsoil to be royal or public property, and gave any citizen the right to denounce it anywhere for mining purposes, irrespective of the ownership of the surface. This code prevails today, with few modifications, in all the Spanish-American republics; that its principles were never introduced into Portuguese America is perhaps the chief reason for the present backward mineral development of Brazil.

*'Documentos Relacionados con la Legislacion Petrolera Mexicana', published in 1919 by the Secretario de Industria, Comercio, y Trabajo, Mexico City.

†'Principles of Mining Taxation.' Discussion by me. Trans. A. I. M. E., 1919, p. 709.

In the scrutiny of ancient institutions by the statesmen of the French revolution, property in mines was not overlooked. This is indicated by the following speech of Mirabeau. "If it be asked whether mines are essentially private properties dependent on the surface ownership, I reply that society has created property in land solely on condition that it be cultivated, and from this aspect only its surface is involved. Society has never been able to class as property those objects whose conservation it could not guarantee. How could it prevent a mine from being exploited at 1200 ft. beneath a land-owner who claimed to own it? Common good and justice are the two foundations of property, but neither requires that mines be accessories of the surface. I say that the interior of the earth is not susceptible of division, whereas on the surface it is to the social interest that property be divided." These ideas of Mirabeau, as to the advantage of separating subsoil from surface rights, were later accepted by the legal committee of the French Convention, and were finally, a few years afterward, embodied in the famous Napoleonic code, which now prevails in modern France and Italy.

If we look at the condition of mining property in our Eastern States, either from the standpoint of elementary justice or common sense, we may observe the ridiculous results of the rejection of the ideas of Mirabeau. Some Pennsylvanian farmers draw unearned fortunes in royalties from the coal seams beneath their land; their neighbors, just as worthy in every respect, lack the coal and must therefore plough for a living. One Indian tribe in Oklahoma lives like a family of nabobs, because its lands contain an oil-pool; another tribe has to ride the range if it wishes to eat. Nor is this absurd condition confined to non-metallic mineral lands. In Missouri we find the land-owners of Elvins selling their scrub-oak pastures for $3000 an acre because of the underlying lead ore; in Wisconsin we see the erstwhile German peasants of Platteville living like Junkers on their zinc-ore royalties; in Minnesota we note the roughneck lumbermen of the Mesabi range blossoming out into the millionaire iron-ore fee-owners of Duluth.

"All this may be true", some may say, "and if we had to begin over again we might heed its import; but a multitude of vested rights have arisen under our existing system, and, unfair though they be, it is now too late to make any change." Such arguments are the stock in trade of conservatives in all ages and countries, but they are invalid from the standpoint of human progress. The violent revolutions of history—in Russia, for example—have been caused by the attempts of governments to enforce vested rights that have long been condemned by public opinion as oppressive and unjust. Would it not be a good augury for the stability of civilization if all nations should incorporate in their codes the following principles from the famous Article 27 of the Mexican Constitution? "The Nation will always have the right to impose on private property such taxation as the public interest may require, and to control the natural resources, susceptible of appropriation, for the purpose of conserving them and assuring an equitable distribution of the public wealth. . . . The ownership of the Nation in all mineral deposits and national waters is inalienable and imprescriptible, and working concessions can only be granted to individuals on condition of their regular development as required by law."

Owing to the fact that the United States only controls as owner the landed property of the greatly depleted public domain, and, as sovereign or owner, that of the Alaskan territory and the colonies, any reforms now introduced could only become widely effective by being imitated by the individual States. Nevertheless, I believe a favorable opportunity is now offered to inaugurate a new Federal mining code, as a model for State legislation in that epoch, not far ahead, when all the public domain of any economic value shall have become private property.

The separation of surface from subsoil rights could be arranged easily, both for future leaseholds on the public domain, and for freeholds as well as leaseholds in the national territories or colonies. In the former case a prospector would henceforth be allowed to locate only the subsoil rights as a mineral claim; any surface he might require he could purchase either from the Federal government or from its private owner, as the case might be, to facilitate which, mining should be declared a public use as under the Napoleonic code and in Australia‡; a cheap, quick, and simple procedure should be provided for the legal application of eminent domain. The separation, in the case of existing leaseholds or freeholds under Federal jurisdiction, would imply a new statute for the division of surface from subsoil property in the official tax-lists, so that each could be taxed independently. There would be no need for separating land-rights in existing deeds or records; such separation would only be required for all sales post-dating the new statute.

The adoption of this separation system on the public domain would save further expense for the payment of geologists needed to classify it into 'mineral' and 'non-mineral' land—a classification that is sure to be faulty at best. By the taxing of subsoil rights separately, at a sufficiently high rate to discourage speculation, the bulk of such rights where economic minerals were yet undiscovered could be recovered gratis by the Government at tax sales. Thus vast subsoil areas now controlled by stockmen or farmers would again be open to prospectors, who would thus regain the rights that were usurped when a multitude of surface-owners claimed the subsoil in spite of its exemption in their original titles from the Nation. By the sincere enforcement of such provisions, we would soon reach the ideal condition for the working, as distinguished from the parasitic, miner—when all subsoil rights would be freely open to exploration and development, without consulting the surface-owners, except in cases where the ground had already been opened for minerals.

I agree with most of the contributors to the discussion in deeming objectionable many of the regulations of the

‡'Mining Laws of Australasia', by A. C. Veatch, Bull. U. S. Geological Survey, No. 505.

new law. The attempt to locate most metal-mining claims in the same way as agricultural land, by means of section lines, could only be advocated by persons who have had little experience as mineral surveyors. Mineral deposits were created 'every which way' as to direction, and should be located solely with reference to the latter, so as to occupy the least possible area. Then some fixed point on the claim should be connected on the map with a central monument, natural or artificial, for the whole district. This is now the rule in Mexico, where in most districts there is a village church to select as the monument of reference. Thus, all the claims in a district can be plotted on a single map, and any invasions or overlaps can be detected easily, irrespective of public-land surveys, whose presence or absence is of no concern to us here.

Next, I consider a 10-acre unit of location far too large; the Mexican unit—the hectare—is just right, and could be adopted easily in English measure by taking a square of 33 ft., which covers 2.5 acres. Some day, I hope, the foot will be everywhere abandoned entirely in favor of the metre, and the suggested unit will then be in harmony. With the hectare-unit a claim can be constructed to fit any vein-system closely, by using the hectares as blocks that are built up into a rectangular polygon.

It is clear that the present system of registering claims in the County Recorder's office is convenient, but the Recorder should be required to report each new claim to the nearest U. S. Land Office. A claim should be monumented, within a few months of location, with masonry posts at its corners and sides, so that anyone, without being a surveyor, can follow it. Lastly, there should be provision for nullifying a claim, forfeited for default of development or tax requirements, at the request of anyone interested; so that after a short time for publication it would be again open for location.

ROBERT B. BRINSMADE.

Ixmiquilpan, Mexico, September 1.

Flotation of Precious Metals

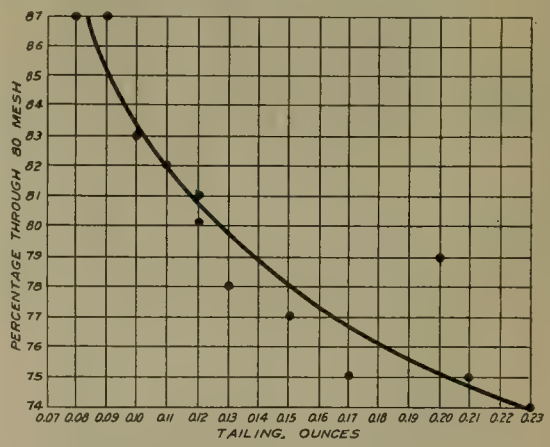
The Editor:

Sir—Both native gold and native silver may be floated after the ores have been ground in a ball-mill. I venture to state that this is not common knowledge, although it has been mentioned by several metallurgists. There are many mines that cannot be worked profitably because such metals will not amalgamate, and the presence of oxidized copper minerals prohibits the use of the cyanide process. For such ores the flotation process may prove successful. I say "may" because the process must be tried first; for although gold may float from one it may not float from another.

These notes refer to two commercial mills operating at a profit, and not to laboratory experiments; the mill treating the native silver ore will be referred to as the silver-mill, and that treating the gold ore as the gold-mill. In both the classifier overflow fed the flotation machines; K & K flotation machines were used. The K & K has the advantage over other machines in that one portion may be used as a rougher while another section is cleaning. In treating a gold or silver ore this is important, for the bulk of concentrate produced is comparatively small, and it is a distinct advantage to be able to change the cleaning space at will.

In the silver-mill, coarse native silver lodged in the eddies at the discharge of the ball-mill, and fine flake-silver could be seen in the concentrate. In the gold-mill, coarse gold could be panned from the ball-mill discharge, fine gold could be panned from the concentrate, but no gold could be panned from the tailing. In both mills, a mixture of crude-oil and No. 5 General Naval Stores pine-oil was used for floating the metals; neither soda ash nor sodium sulphide proved advantageous.

Amalgamation may be conducted in a ball-mill or classifier circuit when crude-oil or Diesel oil is used in the ball-mill; in the gold-mill the crude-oil proved to be beneficial. When amalgamating without crude-oil, the



FINE GRINDING AND TAILING CONTENT

plates fouled rapidly; with the crude-oil ground into the ore the plates remained bright and active, the sulphides and semi-oxidized products being carried over with the oil without touching the plates. The results in the gold-mill were good, whether or not the plates preceded the flotation machine, but nevertheless it was considered best to amalgamate as much gold as possible.

It is difficult to define the necessary conditions for the successful flotation of native metals, but I can say that fine grinding is required; all the pulp should pass 80-mesh. The graph shown herewith illustrates the rise and fall in the assay-value of the tailing as the screen-analyses showed finer or coarser grinding. Finer grinding meant less capacity, but when reduced to profit and loss it showed a gain.

From my experience I can say that a dilute pulp, for example, 1 of ore to 7½ of water, is not disadvantageous; a thin and light froth is better than a heavy, thick, and persistent one. The classifier discharge, when using a ball-mill on crusher product, may be kept at a moderate moisture content without the use of a thickener; but, if

stamps precede the ball-mill and no thickener is used, the classifier discharge may contain as much as 8 parts of water to 1 of ore.

When floating a native-metal ore containing only a small amount of sulphide minerals the concentrate contains a large proportion of gangue, for it is not probable that ore could be concentrated to a ratio over 200 to 1 without making an unmarketable middling or a high-grade tailing. For a ½-oz. gold ore this would mean a $2000 concentrate. I venture to state that a 100 to 1 ratio is more likely; as, even in an 80-mesh product, much of the gold is not entirely free from gangue; and, in order to float the very fine gold, most of the slimed oxides must be carried in the froth.

I do not think that a small testing-machine will give satisfactory results on free-metal ores in those instances where the amount of metal is small as compared with the bulk of the ore; for conditions are more easily regulated when treating a greater bulk. A small test-mill of 10 to 20 tons per day will give results that may be duplicated on a much larger scale. An example will suffice: With a small machine a test showed an extraction of 41%; this was verified at the start in a 20-ton mill; but, by gradually altering conditions and noting results, the extraction was doubled in a short time. Another case I may cite to show how time and conditions may affect results: In a silver-lead-zinc mill for many months the tailing assayed from 3 to 5 lb. zinc per ton; by continually increasing the amount of froth in the roughing machine this loss was reduced to 0.5 to 0.8 lb. per ton. These variations in operating results can only be obtained when treating a sufficient bulk of material and where a small variation will produce a very small change.

The silver ore treated in the silver-mill at times contained a considerable polybasite, but the results were the same as when native silver predominated. The following figures show the every-day results at the silver-mill; samples were taken on each of the three shifts and then averaged for the day; the average given covers two months operation: heads, 11.27 oz. silver; tailing, 1.5 oz.; and concentrate, 1189 oz. This gives a ratio of concentration of 121 to 1 and an extraction of 86%. The actual recovery was not determined; the concentrate was not gathered daily but allowed to settle and then dried.

The results at the gold-mill, when treating an oxidized gold ore containing lead carbonate and in which but 8% of the gold could be amalgamated on plates, averaged in gold content: heading, 0.87 oz.; tailing, 0.14 oz.; concentrate, 22.2 oz.; ratio of concentration, 25 to 1. The extraction was 84%, which tallied closely with the actual recovery.

My aim in writing this is to show that a silver or gold ore in which the metals are in a native state and cannot economically be recovered by amalgamation or cyanidation may be treated profitably by flotation. I hope others who have had experience along these lines will give their ideas.

ALGERNON DEL MAR.

Los Angeles, September 1.

Surface-Tension in Flotation

The Editor:

Sir—Your issue of August 13 contained an article by A. Fahrenwald giving methods and data on measurements of surface-tension. Your contributor quotes the Willard Gibbs formula. $U = \frac{c}{RT}\frac{ds}{dc}$, "where U is the excess concentration at the boundary surface in grammes per centimetre, c is the concentration of solute in the bulk of the solution, R is the constant of the simple gas equation, T is the absolute thermodynamic temperature, and s is the interfacial tension". It is pertinent to point out that, as yet, this formula has not been proved to be true for colloidal solutions and can be applied properly only to cases of true solutions.

Further, Fahrenwald's measurements were made by a static method; measurements by a dynamic method would probably give data of greater interest. Lord Rayleigh devised a dynamic method by which surface-tensions of liquids were measured before the surfaces were one-thousandth of a second old.

That such measurements of surface-tension would be of interest, with reference to the relative persistence or lack of persistence of a froth, is indicated by the following figures, taken from Freundlich's 'Kapillarchemie', p. 56.

		Dynes per centimetre	
		static	dynamic
Water		75	75
Sodium oleate	0.025%	55	79
" "	0.25%	26	79
" "	1.25%	26	62
" "	2.5%	26	58
Heptylic acid	0.005N	54	68

In the usual agitating-frothing machines, fresh liquid surfaces are made rapidly, and the values of surface-tension obtaining are obviously between the static and dynamic values.

A. C. HALFERDAHL.

Seattle, September 8.

Silver in the Philippines

The Editor:

Sir—I call your attention to a misstatement in the issue of July 9, taken from a consular report, in regard to silver deposits in Bulacan, Paracale, Cebu, Marinduque, and Mindanao, in the Philippine Islands. I have seen the same mistake in a bulletin of the American Mining Congress.

The Division of Mines of the Bureau of Science has no knowledge of silver deposits in the Philippines. Such silver as occurs in the ores is usually alloyed with gold. We have no knowledge of commercial deposits of silver. Native silver has been found in minute quantities in one or two places and there is some argentiferous galena in two or three localities. All of these deposits, however, are unimportant.

WARREN D. SMITH,
Chief, Division of Mines.

Manila, P. I., August 26.

Huxley: The Exponent of Veracity

By T. A. Rickard

*Huxley was one of the group of scientific men associated with the birth of the central doctrine of evolution; he was a personal friend of Darwin and his militant ally during the bitter controversies arising from the publication of the 'Origin of Species'. That was in 1859—62 years ago—yet the modern world still feels the intellectual impulse of that first declaration of the Darwinian hypothesis, to establish which Huxley devoted the best of his powers as an expositor and dialectician.

It may be worth while to recall the romantic story of the announcement of Darwin's discovery of the principle of natural selection. He had been prepared to think on the subject, and to collect notes for his study of it, by his voyage as official naturalist on board the 'Beagle', a vessel used by the British government in the survey of the southern end of South America during five years, from 1831 to 1836, but he did not see the light until 1837, after his return home, when he had begun to compare the relations of existing with extinct species and the species of different geographic areas with one another. In 1842 he wrote a brief sketch of his theory in pencil and two years later he elaborated this into an essay of 230 pages. He was sufficiently convinced of the importance of his work to make arrangements for its publication in case of his death. Only two or three friends were cognizant of his views; among those friends were Lyell, Hooker, and Huxley. Early in 1856 he began to write on an extended scale, and in July of that year he outlined his theory in a letter to Asa Gray, of Harvard; he was engaged in preparing his book when in June 1858 he received a letter from Alfred Wallace, a naturalist, who was then in the Malay Peninsula, and with whom he had been corresponding. With this letter from Wallace he received an essay in which Wallace propounded almost exactly the same views as his own. As Darwin said at the time: "If Wallace had my manuscript sketch written out in 1842, he could not have made a better short abstract". It was an astonishing coincidence, and, of course, a great blow to Darwin. What did he do? He was a gentleman in the best sense of that much abused word. His first impulse was to publish Wallace's essay without comment of his own, but Lyell and Hooker suggested that extracts from his manuscript of 1844 and from the letter to Asa Gray should be communicated to the Linnean Society along with Wallace's essay. This was done on July 1, 1858. Hooker, describing the meeting, said that "the interest excited was intense, but the subject was too novel and too ominous for the old school to enter the lists before armoring. After the meeting it was talked over with bated breath". Darwin and Wallace remained friends to the end of their lives. Wallace acknowledged generously that while he had been the originator of the theory, he could not have written the 'Origin of Species', nor persevered, as Darwin did, in accumulating and using large masses of facts of the most varied kind in the preparation of vast generalizations. The true spirit of science and the instincts of fine character were never better exemplified than in the sayings and doings of the great men who introduced the theory of evolution into the world. Huxley was the most brilliant and in many respects the most remarkable member of that group.

Thomas Henry Huxley: the name fits the man. He was unaffected, passionately sincere, gloriously belligerent, ever a fighter who marched breast forward. His first name, as he said himself, was that of the "particular apostle with whom he had always felt most sympathy": Thomas, the doubter. See John XX, 25. The philosophy of doubt in his hands became the key to scientific truth. Descartes and Hume were his exemplars. Often he quoted the resolution made by Descartes: "To take nothing for truth without clear knowledge that it is such", the practical effect of which is the sanctification of doubt. He took no direct pleasure in doubting, however, but used it as a means of making knowledge doubly secure. As he said:

"The development of exact natural knowledge in all its vast range, from physics to history and criticism, is the consequence of the working out, in this province, of the resolution to take nothing for truth without clear knowledge that it is such; to consider all beliefs open to criticism; to regard the value of authority as neither greater nor less than as much as it can prove itself to be worth. The modern spirit is not the spirit 'which always denies', delighting only in destruction; still less is it that which builds castles in the air rather than not construct; it is the spirit which works and will work 'without haste and without rest', gathering harvest after harvest of truth into its barns and devouring error with unquenchable fire."

Huxley was born in 1825, in the village of Ealing, now a suburb of London. Like Herbert Spencer, he was the son of a schoolmaster. From his father he inherited a hot, but generous, temper, an inborn faculty for drawing, and a tenacity of purpose, "which", as he said, "unfriendly observers sometimes called obstinacy". To his mother he owed much more, especially rapidity of thought. Of her he says: "If one ventured to suggest she had not taken much time to arrive at any conclusion, she would say, 'I cannot help it, things flash across me'. That peculiarity has been passed on to me in full strength; it has often stood me in good stead; it has some-

*An address delivered at the Commencement of the Montana School of Mines, at Butte, on June 3, 1921.

times played me sad tricks, and it has always been a danger. But, after all, if my time were to come over again, there is nothing I would less willingly part with than my inheritance of mother wit". He was one of the wittiest men of his time. During a dinner at the Athenaeum club, Spencer remarked: "You would not think it, but I once wrote a tragedy". Huxley exclaimed, "I know the catastrophe". Spencer asked what it was. Huxley replied, "A beautiful theory killed by a nasty ugly little fact". That is Galton's version. Others have been quoted; for instance: "Spencer's idea of a tragedy is a deduction killed by a fact". Upon another occasion some of his friends were discussing habits of composition, most of them acknowledging their difficulty in getting into the swing of it. Whereupon Lewes exclaimed, "I never hesitate. I get up steam at once. In short, I boil at a low temperature". "Well, but", remarked Huxley, "that implies a vacuum in the upper regions." When Archbishop Benson helped him to put on his overcoat, he said: "Thank you, I feel as if I were receiving the *pallium*". Once during a lecture, turning to a student, he asked: "Well, I hope you understand it all". "All, sir, but one part, during which you stood between me and the blackboard", was the reply. Huxley rejoined: "I did my best to make myself clear, but could not render myself transparent".

His regular schooling was scant and poor, but he was an eager reader of books and made the most of his father's library. Picture him as a boy of twelve, lighting a candle before dawn, pinning a blanket about his shoulders, and sitting up in bed in order to read Hutton's 'Geology'. He had an intense curiosity to discover the motive principle of things and early showed a love for metaphysics, engineering, and anatomy. The fact that he had a medical brother-in-law appears to have been the chief reason why he commenced the study of medicine while still a small boy. When not yet 14 years old he attended his first post-mortem examination, and somehow was poisoned. Although he soon recovered from the immediate effects, he suffered from hypochondriacal dyspepsia the rest of his life. Like his friends, Darwin and Spencer, he accomplished a great work despite persistently poor health. Thus will the spirit of man—of great men—triumph over obstacles that suffice to drive weaker men to despair. He persevered in his studies. The reading of Carlyle prompted him to begin the learning of German at 15. He also learned French. In after years he mastered Italian in order to read Dante and late in life he took up Greek, for scientific use and to read Homer in the original. His ability to read foreign literature proved immensely valuable to him, giving him an early acquaintance with German method and French philosophy, besides widening his intellectual sympathy with other races. To good music he was always susceptible. When 17 years old he obtained a scholarship at Charing Cross hospital, where he came under the stimulating influence of an excellent teacher, Wharton Jones, the lecturer in physiology. He won prizes and medals, and otherwise demonstrated the budding powers of his mind. When just 21, and still too young to qualify at the College of Surgeons, he applied for a post in the Medical Service of the Navy, and in October 1846 he was appointed assistant-surgeon on the 'Rattlesnake'. That was the turning point of his career.

It is noteworthy that Huxley, Darwin, and Hooker alike were enabled to study natural history by means of a marine curriculum. Darwin sailed on the 'Beagle' in 1831, Hooker on the 'Erebus' in 1839, Huxley on the 'Rattlesnake' in 1846. In later years, armed with the knowledge acquired during their voyages, they stood together in the fight against the theory of an immutability of species. Each of the ships to which they were commissioned was sent forth on a scientific mission; to the 'Rattlesnake' was assigned the survey of the passage between the Barrier Reef and the north-eastern coast of Australia, and the exploration of the sea from there northward to New Guinea. It proved a fine apprenticeship for the study of biological problems and helped Huxley to become the foremost expositor of the doctrine of evolution.

He remained on the 'Rattlesnake' four years. During this period he used the microscope assiduously in examining the specimens of marine life collected by the dredge and the tow-net, supplementing his observations with conscientious drawings of innumerable dissections. While Huxley was engaged in this work on board ship amid the coral reefs of the southern seas, forming a new conception of the animal kingdom as a varied set of modifications of a single type, Darwin at his quiet home in rural England was slowly working toward a philosophic explanation of the variation of species by modification and was preparing to formulate the fundamental concept of modern science.

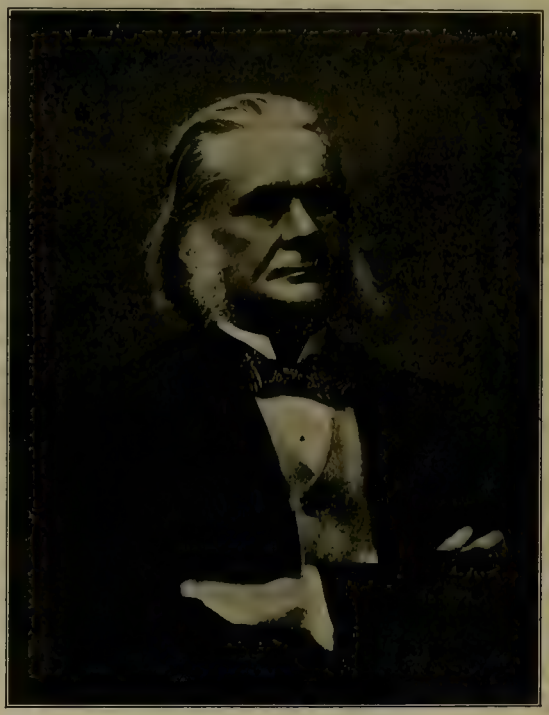
While attached to the 'Rattlesnake', Huxley wrote numerous papers; for one of these, on the structure of the Medusae, he was given the blue ribbon of British science, fellowship of the Royal Society. On his return, after the long voyage in distant parts, he wrote a number of other papers, which won recognition and many medals; but they did not provide bread and butter. He was poor. At this juncture, in 1854, when he was 27, he and Tyndall applied for appointment to the chairs of natural history and physics respectively in the University of Toronto. Both were rejected. One cannot forbear from speculating upon the consequences to North American science and culture if these two men had taken root on this side of the Atlantic. Possibly their usefulness on a larger scale would have been impaired; probably they would have done less well in the absence of the stimulus given to both by being in the midst of great controversies in Europe. Instead of going to Canada, Huxley obtained the professorship of paleontology and the lectureship on natural history in the Royal School of Mines, which in later years has been annexed to the Imperial College of Science and Technology at South Kensington. From these two appointments he drew the lordly salary of £200 per annum! yet he held them for 31 years, until "that accursed hag, dyspepsia" and

other ailments compelled him to retire in 1885. Four years after his appointment at the School of Mines, he was joined by Tyndall, as professor of physics. Hitherto Huxley's work had been concerned with invertebrates, now he had to cover a much wider field. Soon he acquired an ample knowledge of paleontology, thereby arming himself further for elucidating the problems that became so hotly contested as soon as Darwin's 'Origin of Species' was published in 1859. He used the Museum of Practical Geology as an educational instrument. Indeed, characteristically, he became keenly interested in the organization and use of museums; he re-arranged the courses of study at the School of Mines; and began a set of lectures to working-men. These are famous now; they were as fit for Prime Ministers as for working-men and enabled him to acquire the tremendously difficult art of talking about scientific subjects in plain English, an art he mastered so thoroughly that he became the greatest scientific expositor of his time. In the following year, 1855, he became naturalist to the Geological Survey, with an additional salary of £200, afterward increased to £400. Various lectureships were offered to him in quick succession. At last he had an income that allowed him to marry Henrietta Heathorn, whom he had met and to whom he had become engaged while on a visit to Sydney, in Australia, eight years previously. His dislike of prevarication is shown by an incident at this time. Miss Heathorn was in bad health; he took her to a famous doctor as if she were merely a patient in whom he was interested. Then, as one doctor to another, he asked the specialist for his private opinion of the case. "I give her six months to live," said he. "Well, six months or not", replied Huxley, "she is going to be my wife." The doctor was annoyed. "You might have told me that before." It was the evasive answer in such a contingency that Huxley wished to avoid. Fortunately another specialist gave a more hopeful opinion, which proved correct. Mrs. Huxley outlived her husband, who himself lived to be 70 years old; she was the mother of boys and girls that have become men and women of note.

Once started, he advanced steadily, making enough money, as lecturer and writer, to pursue his own researches and live in the style of a successful professional man. He became a persistent advocate for scientific education in schools and colleges; he aroused public interest in biology and in other sciences, such as geology; he awakened the curiosity of large audiences in natural history; he co-operated with Roscoe and Balfour Stewart in an organized endeavor to diffuse scientific knowledge among all classes. And he succeeded. In his prime he was recognized as the greatest expositor and dialectician of the period. He was illuminating and penetrating even to minds poorly prepared for his teaching. Take, for example, his lecture 'On a Piece of Chalk', as delivered to the working-men of Norwich in 1868. He begins by holding a piece of white stuff before the eyes of his audience, he tells them it is carbonate of lime, he explains how it is built of dead organisms buried on the bottom of the sea, he shows how out of their substance the cliffs of Albion have been formed, he reads the story of evolution as written on the face of the rocks, he recounts "the fairy tales of science and the long result of time", and so passes the current of his genius through the piece of chalk that it becomes incandescent to the dullest intelligence.

He was the recognized exponent of Darwinism. Of him it could be said, as of Luther in relation to Erasmus, that he hatched the egg that Darwin laid. Without his powerful advocacy the doctrine of evolution would have made slow progress in the minds of the world at large. He was a pioneer of human thought, an explorer who cut his way through the stifling jungles of myth and the muddy morasses of ignorance to the cool high summits of scientific truth.

Among the events in Huxley's life that typify his



THOMAS HENRY HUXLEY

character and achievement, I shall try to describe two. The first was the dialectic combat with Owen and Wilberforce in 1860. In that year the British Association for the Advancement of Science met at Oxford. The air was full of the controversy over Darwin's book, 'Origin of Species', which had been issued in the preceding November. On December 26 the 'Times' published a review, which, although unsigned, was written by Huxley, to whom fortunately the official reviewer of the 'Times' had turned for help, being himself unversed in scientific matters. Thus Huxley was given an early opportunity to write a splendid essay in support of evolution. Darwin, at first, was not aware of the identity of the reviewer, but, as soon as he saw the article, he said, "Whoever the man is, he has done great service to the cause". Most of the press notices of the book were unfavorable.

In the following April Huxley contributed a long article to the 'Westminster Review', praising Darwin's work and insisting upon natural selection as the only satisfactory hypothesis then in the field. In the same month the 'Edinburgh Review' published a vicious assault not only upon the 'Origin of Species' but also upon Darwin and Huxley. This was marred by personal abuse and displayed a venom that shocked them and their friends. The article was not signed, but its range of knowledge and the style of its argument betrayed its authorship. Only Sir Richard Owen could have written it. He was then the most distinguished anatomist in England, prominent in fashionable society, a leader among scientific men, brilliant, perverse, and unscrupulous. He was jealous of the new group of men—Darwin, Huxley, Hooker, and Lyell—who were threatening his premier position in English science, and he had been urged by Wilberforce, the Bishop of Oxford, together with Sedgwick, Whewell, and other church people, to stamp out "the pernicious doctrine" of evolution. Another article appeared in the July issue of the 'Quarterly Review'; this was recognized as the work of Wilberforce himself, who, assisted by Owen, made a bitter drive on Darwin. Seventeen years afterward, in 'Darwin's Life and Letters', Huxley wrote of this article as follows:

"I doubt if there was any man living who had a better right [than Darwin] to expect that anything he might choose to say on such a question as the origin of species would be listened to with profound attention, and discussed with respect. And there was certainly no man whose personal character should have afforded a better safeguard against attacks instinct with malignity and spiced with shameless impertinence. . . Since Lord Brougham assailed Dr. Young, the world has seen no such specimen of the insolence of a shallow pretender to a master in science as this remarkable production, in which one of the most exact of observers, most cautious of reasoners, and most candid of expositors, of this or any age, is held up to scorn as a 'flighty' person who endeavors to 'prop up his utterly rotten fabric of guess and speculation', and whose 'mode of dealing with nature' is reprobated as 'utterly dishonorable to natural science'. And all this high and mighty talk, which would have been indecent in one of Mr. Darwin's equals, proceeds from a writer whose want of intelligence, or of conscience, or of both, is so great, that, by way of an objection to Mr. Darwin's views, he can ask, 'Is it credible that all favorable varieties of turnips are tending to become men'; who is so ignorant of paleontology that he can talk of the 'flowers and fruits' of the plants of the Carboniferous epoch; of comparative anatomy, that he can gravely affirm the poison apparatus of venomous snakes to be 'entirely separate from the ordinary laws of animal life, and peculiar to themselves'; of the rudiments of physiology, that he can ask, 'what advantage of life could alter the shapes of the corpuscles into which the blood can be evaporated?' Nor does the reviewer fail to flavor this outpouring of incapacity with a little stimulation of the *odium theologicum*. Some inkling of the history of the conflicts between astronomy, geology, and theology leads him to keep a retreat open by the proviso that he cannot 'consent to test the truth of natural science by the word of revelation', but for all that he devotes pages to the exposition of his conviction that Mr. Darwin's theory 'contradicts the revealed relation of the creation to its Creator', and is 'inconsistent with the fullness of His glory'."

I have quoted at some length because this description of the article gives one a fair idea of its character and also of the strong feeling it aroused among Darwin's friends. These various fulminations had created an electric atmosphere for the meeting of the British Association at Oxford in the last days of June 1860. It was known that Wilberforce had written an article against Darwin in the current 'Quarterly' and it was rumored that attempts would be made to attack Darwin's theory in such a way as to discredit it in the eyes of the public. Indeed, Huxley, anticipating an appeal to the prejudice of a mixed audience, including ladies, had intended to leave Oxford after the opening session of the Association, but he was urged by Robert Chambers, the author of 'Vestiges of Creation', not to desert his friends. So he stayed. Two papers in Section D gave Darwin's enemies an opening for attack. On Thursday, June 28, a paper was read by a Dr. Daubeny 'On the final causes of the sexuality of plants, with particular reference to Mr. Darwin's work on the origin of species'. The President, Professor J. S. Henslow, asked Huxley to speak, but he declined, on the ground that a general audience so swayed by sentiment was not suited for the scientific discussion of such a subject. However, Owen did not hesitate to enter the lists. He said that he "wished to approach the subject in the spirit of the philosopher" and declared "his conviction that there were facts by which the public could come to some conclusion with regard to the probabilities of the truth of Mr. Darwin's theory". Thereupon, as one of his facts, he stated that the brain of the gorilla "presented more differences, as compared with the brain of man, than it did when compared with the brains of the very lowest and most problematical of the Quadrumana", that is, there were anatomical differences not merely of degree but of kind between the brain of man and that of the highest ape. The audience accepted the announcement as a smashing blow at the theory of descent. It happened, however, that this was a point that Huxley had investigated most carefully during the two years previous, coming to a conclusion precisely opposite, and in accord with earlier investigators. He gave Owen a "direct and unqualified contradiction", and pledged his reputation to "justify that unusual procedure elsewhere". This pledge he fulfilled to the hilt in the following year in the pages of the 'Natural History Review' and in public lectures. Owing to the prominent position taken by Huxley, against his wish, at this session of Section D, it was to him that Bishop Wilberforce directed his sarcasm two days later. Samuel Wilberforce, the Bishop of Oxford, nicknamed 'Soapy Sam' by his enemies, appears to have been eloquent, but shallow; al-

though lacking precise knowledge in letters or science, he did not hesitate to assume leadership of the clerical party in the battle of the species; armed with a little natural history picked up from Gosse and a few anatomical facts gleaned from Owen, he had the effrontery to challenge such earnest students of nature as Darwin and Huxley. On Saturday, June 30, Dr. Draper of New York presented a paper on 'The Intellectual Development of Europe considered with reference to the views of Mr. Darwin'. This paper was not remarkable, but it was known that the Bishop was going to use it as a text for his eloquence, so members of the Association came in such numbers to the meeting that it had to adjourn to a larger room, into which more than 700 people managed to crowd. Even the windows, by which the room was lighted along one side, were banked with ladies, fluttering with excitement. On the opposite side, between the two doors, was the platform, on which sat the president of the section, Professor Henslow; on his right was the Bishop; beyond him were Dr. Draper and others; on the president's left were Sir Joseph Hooker, Sir John Lubbock, Professor Beale, and Huxley. In the centre of the room sat a group of the clergy, who shouted for the bishop; in a corner stood a knot of undergraduates, including John Richard Green, the future historian, ready to cheer the Darwinians. For an hour Dr. Draper droned out his paper, turning first to the right and then to the left, as he made various references to the 'Origin of Species'. "Air we a fortooitous concourse of atoms?" he asked as he sat down. After him came a layman, who, in stentorian tones, let off his theological steam. Then a thin voice echoed him in more scholarly fashion. Third, a Mr. Dingle undertook to prove that Darwin made a fatal blunder in not consulting him, the speaker. Turning to the blackboard he proceeded to demonstrate. "Let this point A be maun, and let that point B be the mawnkey". He went no further; derisive shouts of "mawnkey" put a summary end to his disquisition. At this stage of the proceedings the president announced that none except those having valid arguments to bring forward would be allowed to address the meeting. There were calls for the bishop, but he rose only to state that he understood his friend Professor Beale had something to say first. Beale, an excellent histologist, said that the new theory ought to meet with fair discussion, but he added, modestly, that he himself had not sufficient knowledge to discuss the subject adequately. Then the bishop rose to make his famous speech. It was evident that he had been crammed for the occasion, he used the arguments of his 'Quarterly' article, he ridiculed Darwin bitterly and Huxley savagely, but all in such dulcet tones, with so persuasive a manner, and with such well-turned periods that he gave keen pleasure to most of those present. For half an hour he spoke with inimitable spirit, emptiness, and unfairness. In a light scoffing tone, florid and fluent, he assured his hearers that there was nothing in the idea of evolution; rock-pigeons were what rock-pigeons had always been. Then turning to Huxley with a smiling insolence, he asked, was it through his grandfather or his grandmother that he claimed his descent from a monkey? Huxley realized instantly the tactical blunder of this vulgar descent into personalities. Turning to a friend sitting next to him, and striking his hand emphatically on his knee, he said, "The Lord hath delivered him into my hands". The bishop sat down amid loud applause, led by his clerical friends, while from the opposite side of the room the ladies waved their white handkerchiefs rapturously. Huxley rose slowly and deliberately. He was only 35. Slight in figure, pale and stern in face, quiet and grave in manner, cool and scientific in utterance, he made a retort that still rings through the halls of philosophy. After setting a good example by demonstrating his case with evidence, refuting Owen, Huxley turned to the bishop and said:

"I have asserted—and I repeat—that a man has no reason to be ashamed of having an ape for his grandfather. If there were an ancestor whom I should feel shame in recalling it would rather be a *man*—a man of restless and versatile intellect—who, not content with an equivocal success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance, only to obscure them by an aimless rhetoric, and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice."

It remains to record that 34 years later, in the same city of Oxford, Lord Salisbury, a rigid High Churchman, in his presidential address before the British Association, said:

"Few now are found to doubt that animals separated by differences far exceeding those that distinguish what we know as species have yet descended from common ancestors . . . Darwin has, as a matter of fact, disposed of the doctrine of the immutability of species."

From that day Huxley became the apostle Paul of the Darwinian movement; by his essays, lectures, and studies, continued to the end of his life, he endeavored to convince, and succeeded in convincing, the intellectual world. He left his impress upon his own generation and upon those after him. He influenced the men that influence the thought of our own day. Through them his mind is active still.

The other event in his life that I venture to describe came near the end, in 1893, when he delivered the Romanes lecture, on 'Evolution and Ethics', at Oxford. A lectureship had been founded by J. G. Romanes, a zoologist and professor of Oxford. In 1892 Gladstone delivered the first of this series. It is worthy of note that at one time it looked as if Gladstone might be prevented from lecturing, whereupon Romanes asked Huxley to be prepared to step into the breach. He replied: "I am afraid that age hath not altogether cleared the spirit of mischief out of my blood; and there is something so piquant in the notion of my acting as substitute for Gladstone that I will be ready if necessity arise". It will be remembered that six years earlier (in 1886) he had crossed swords in controversy with the famous English statesman, when that great exponent of

British orthodoxy endeavored laboriously to reconcile the story of creation in 'Genesis' with the evidence of geology. However, Gladstone did deliver his lecture, so that Huxley's turn came the year after.

He was embarrassed by the fact that, by the terms of the foundation, both politics and religion had to be eschewed. In his careful avoidance of these topics he was compelled, as he said, to execute an 'egg-dance'; but there were no signs of difficulty in his exposition. On the afternoon of May 18, 1893, he faced a brilliant throng in the Sheldonian theatre. It was a great contrast to the meeting in the Museum thirty-three years previously, when as a young man he had championed the cause of science before a hostile audience. Then he was just becoming known as an exponent of Darwinism; now, largely by his own efforts, the theory he upheld had become an integral part of human thought, and he himself was the honored guest of the university. A year before he had been made a member of the Privy Council; he was the Right Honorable Thomas Henry Huxley, after having refused other, simply titular, honors. In the academic theatre there was assembled the best thought of England. Graduates from distant parts had come to hear him and every member of the University that could gain admission was there to follow his every word with the deepest respect. The press of the world was fully represented and as eager to report his lecture as if he were the leader of a nation about to utter a historic pronouncement. Although he was still feeling the effects of an attack of influenza and his voice had not its usual resonance, he rose to the occasion with his old unconquerable spirit. He looked splendid in his D. C. L. robes, with the silver-gray hair sweeping back from his fine forehead, the leonine squareness of his features tempered by the benignity of old age, and the glance of his deeply set eyes softened by the common joys and sorrows of a long life. His lecture dealt with the antagonism between the cosmic process of nature and the ethical progress of man; the forces of wild nature and the products of sentient humanity; the jungle against civilization. He insisted that the ethical systems based on the principle of cosmic evolution were logically unsound. The doctrine of "biological necessity" brought forward by the Prussian seven years ago was a direct contradiction to Huxley's philosophy as expressed in this famous lecture. As he said, humorously, "My lecture was really an effort to put the Christian doctrine, that Satan is the Prince of this world, upon a scientific foundation". He believed that evolution accounted for morality, but he denied that the principle of evolution in general could be adopted as an ethical guide. In an earlier essay he had said: "The notion that the doctrine of evolution can furnish a foundation for morals seems to me to be an illusion that has arisen from the unfortunate ambiguity of the term 'fittest' in the formula, 'survival of the fittest'. We commonly use 'fittest' in a good sense; with an understood connotation of 'best'; and 'best' we are apt to take in its ethical sense. But the 'fittest' to survive in the struggle for existence may be, and often is, the ethically worst." I quote the conclusion of his lecture:

"Much may be done to change the nature of man himself. The intelligence which has converted the brother of the wolf into the faithful guardian of the flock ought to be able to do something towards curbing the instincts of savagery in civilized men. But if we may permit ourselves a larger hope of abatement of the essential evil of the world than was possible to those who, in the infancy of exact knowledge, faced the problem of existence more than a score of centuries ago, I deem it an essential condition of the realization of that hope that we should cast aside the notion that the escape from pain and sorrow is the proper object of life. We have long since emerged from the heroic childhood of our race, when good and evil could be met with the same 'frolic welcome'; the attempts to escape from evil, whether Indian or Greek, have ended in flight from the battlefield; it remains to us to throw aside the youthful overconfidence and the no less youthful discouragement of nonage. We are grown men, and must play the man

'strong in will
To strive, to seek, to find, and not to yield,'

cherishing the good that falls in our way, and bearing the evil, in and around us, with stout hearts set on diminishing it. So far, we all may strive in one faith towards one hope:

'It may be that the gulfs will wash us down,
It may be we shall touch the Happy Isles,
. . . . . but something ere the end,
Some work of noble note may yet be done.'"

Seventeen years later, on June 7, 1910, the Romanes lecturer was Theodore Roosevelt. I heard him address a crowded audience in the same place on the subject of 'Biological Analogies in History'. He compared the cycles of animal life with those of national life. He sketched the geologic history of South America. He drew analogies between the fate befalling the forms of animal life and the destinies of the great artificial civilizations. He compared Rome and Britain; the British empire and the American democracy. He dressed the eternal verities in the garments of his own manly sincerity and gave them the freshness of his own personality. It was a great occasion in Theodore Roosevelt's life, and as I listened to him with warm interest and sympathy, I recognized that his character resembled that of Huxley in its essential manliness, in its high moral courage, in its invincible combativeness. When Huxley arrived in the harbor of New York on his visit to this country in 1876 and watched a tug hard at work in its purposeful way, he exclaimed, "If I were not a man, I think I should like to be a tug". One can imagine Roosevelt saying that. They were both like forceful steam-tugs amid the noisy traffic of life.

At the time of his American visit Huxley delivered the inaugural address at the opening of Johns Hopkins University. On that occasion he spoke on university education, and concluded as follows:

"I constantly hear Americans speak of the charm which our old mother country has for them, of the delight with which they wander through the streets of ancient towns, or climb the battlements of medieval strongholds, the names of which are indissolubly associated with the great epochs of that noble literature which is our common inheritance; or with the blood-stained steps of that secular progress by which the descendants of the savage Britons and of the wild pirates of the North Sea have become converted into warriors of order and champions of peaceful freedom, exhausting what still remains of the old Berserk spirit in subduing nature, and turning the wilderness into a garden. But anticipation has no less charm than retrospect, and to an Englishman landing upon your shores for the first time, traveling for hundreds of miles through strings of great and well-ordered cities, seeing your enormous actual, and almost infinite potential, wealth in all commodities, and in the energy and ability which turn wealth to account, there is something sublime in the vista of the future. Do not suppose that I am pandering to what is commonly understood by national pride. I cannot say that I am in the slightest degree impressed by your bigness, or your material resources, as such. Size is not grandeur, and territory does not make a nation. The great issue, about which hangs a true sublimity, and the terror of overhanging fate, is what are you going to do with all these things? What is to be the end to which these are to be the means? You are making a novel experiment in politics on the greatest scale which the world has yet seen. Forty millions at your first centenary, it is reasonably to be expected that, at the second, these States will be occupied by two hundred millions of English-speaking people, spread over an area as large as that of Europe, and with climates and interests as diverse as those of Spain and Scandinavia, England and Russia. You and your descendants have to ascertain whether this great mass will hold together under the form of a republic, and the despotic reality of universal suffrage; whether state rights will hold out against centralization, without separation; whether centralization will get the better, without actual or disguised monarchy; whether shifting corruption is better than a permanent bureaucracy; and as population thickens in your great cities, and the pressure of want is felt, the gaunt spectre of pauperism will stalk among you, and communism and socialism will claim to be heard. Truly America has a great future before her; great in toil, in care, and in responsibility; great in true glory if she be guided in wisdom and righteousness; great in shame if she fail. I cannot understand why other nations should envy you, or be blind to the fact that it is for the highest interest of mankind that you should succeed; but the one condition of success, your sole safeguard, is the moral worth and intellectual clearness of the individual citizen. Education cannot give these, but it may cherish them and bring them to the front in whatever station of society they are to be found; and the universities ought to be, and may be, the fortresses of the higher life of the nation."

It is assumed by those unfamiliar with Huxley's philosophy that he was irreverent and the avowed enemy of religion. At one time he and his friends were anathema to orthodox church people on account of his advocacy of scientific method in all branches of human thought, including religion. He believed scepticism to be the highest duty and blind faith to be the one unpardonable sin. "Logical consequences are the scarecrows of fools and the beacons of wise men." In order to describe his philosophic attitude, he adopted the term 'agnostic': "Most of my colleagues in the Metaphysical Society were 'ists' . . . and I, the man without a rag of a label . . . took thought and invented what I conceived to be the appropriate title of 'Agnostic'. It came into my head as suggestively antithetic to the 'gnostic' of church history, who professed to know so much about the very things of which I was ignorant."

He engaged in a number of lively controversies over the miracles recorded in the Bible, crossing swords with Gladstone and the Duke of Argyll, for instance, over the story of the Gadarene swine. He and Gladstone fought over the authenticity of the story of creation as told in 'Genesis'. In the course of this controversy he said:

"The antagonism of science is not to religion, but to the heathen survivals and the bad philosophy under which religion herself is often well-nigh crushed." In 'An Apologetic Irenicon', published in 1892, he said:

"It is the secret of the superiority of the best theological teachers to the majority of their opponents that they substantially recognize these realities of things, however strange the forms in which they clothe their conceptions. The doctrines of predestination, of original sin, of the innate depravity of man and the evil fate of the greater part of the race, of the primacy of Satan in this world, of the essential vileness of matter, of a malevolent Demiurgis subordinate to a benevolent Almighty, who has only lately revealed himself, faulty as they are, appear to me to be vastly nearer the truth than the 'liberal' popular illusions that babies are all born good, and that the example of a corrupt society is responsible for their failure to remain so; that it is given to everybody to reach the ethical ideal if he will only try; that all partial evil is universal good, and other optimistic figments, such as that which represents Providence under the guise of a paternal philanthropist, and bids us believe that everything will come right (according to our notions) at last."

In conversation he remarked: "Religions come and go, but religion remains". He was reverent in mind, sympathetic in spirit, and of a lovable disposition to his friends. One of the most characteristic of intellectual exchanges was the correspondence between Charles Kingsley and Huxley on the occasion of the death of the latter's little son, his first-born. Kingsley wrote most feelingly and kindly, offering him the consolations of orthodox Christianity. Huxley replied in a long letter stating his position frankly. He was honest with himself. Speaking of the irregularities of his youth, he wrote: "What do I find to have been the agents of my

redemption? The hope of immortality or of future reward? I can honestly say that for these fourteen years such a consideration has not entered my head. No, I can tell you exactly what has been at work. 'Sartor Resartus' led me to know that a deep sense of religion was compatible with the entire absence of theology. Secondly, science and her methods gave me a resting-place independent of authority and tradition. Thirdly, love opened up to me a view of the sanctity of human nature, and impressed me with a deep sense of responsibility."

Tennyson in his autobiography records a visit from Huxley, and says of him: "He was chivalrous, wise, and earnest, so that one could not but enjoy talking with him". Yes indeed, he was chivalrous, generous, kind, belligerent, intolerant of humbug, a hater of shams. Above everything he had the intellectual courage that glorifies the true leader among men. No weight of authority could alter a conclusion to which he had come in logical consequence of fact, observation, and thought. This courage made him the captain of the forces that fought for the theory of evolution at its birth; it was the natural expression of an intellectual honesty that was invincible, as is shown in his correspondence with Kingsley; by aid of it he emancipated the religious no less than the scientific thought of his day and generation.

In 1870 he was elected a member of the London School Board and took a prominent part in the proceedings. His colleagues "soon found", as Dr. J. H. Gladstone records, "proof of his great energy, and his power of expressing his views in clear and forcible language; but they also found that with all his strong convictions and lofty ideals he was able and willing to enter into the views of others, and to look at a practical question from its several sides". He advocated the retention of the Bible in the schools; "he had", as P. C. Mitchell says, "the inevitable respect of an Englishman for the English Bible as one of the greatest books in our language"; moreover, he thought that "the mass of the people should not be deprived of the one great literature which is open to them, nor shut out from the perception of its place in the whole past history of civilized mankind". To this I venture to add, that no man desiring to acquire skill in the use of our language can afford to neglect that well of English undefiled, the King James version of the Bible. He set an example to men of science by recognizing his duties to society and his obligations to the community in which he lived. Not content to be merely a keen student of science, he was also a zealous citizen, willing to take part in the social movements of his time, giving to them the aid of his special knowledge and method of research. He served on ten Royal Commissions for the collection and examination of evidence needed for intelligent legislation. He was a member of the London School Board, as we have seen. He illuminated public questions by addressing large audiences; he contributed discussions and criticisms to the reviews; he was much more than a scientific specialist, he was a social philosopher of the most potent kind. He brought the rare skill of a scientific expositor to current affairs and familiarized his contemporaries in every walk of life with the value of scientific method. In one of his addresses, for example, he said:

"The vast results obtained by Science are won by no mystical faculties, by no mental processes other than those which are practised by every one of us, in the humblest and meanest affairs of life. A detective policeman discovers a burglar from the marks made by his shoe, by a mental process identical with that by which Cuvier restored the extinct animals of Montmartre from fragments of their bones. Nor does that process of induction and deduction by which a lady, finding a stain of a peculiar kind on her dress, concludes that somebody has upset the inkstand thereon, differ in any way, in kind, from that by which Adams and Leverrier discovered a new planet."

It remains to quote several characteristic utterances of Huxley. We are still debating what are the essentials of a liberal education and we continue to change the curricula in our colleges in an effort to give the youth of our country the best preparation for life. On this subject, as on many others vital to human progress, Huxley had clearly defined ideas. In an address to the South London Working Men's College, in 1868, he said:

"That man, I think has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear cold-logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam-engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness, and to respect others as himself."

On the last day of 1860, musing over his future, he made an entry in his journal, describing his aim in life.

"To smite all humbugs, however big; to give a nobler tone to science; to set an example of abstinence from petty personal controversies, and of toleration for everything but lying; to be indifferent as to whether the work is recognized as mine or not, so long as it is done."

He was then 35. In his old age he looked back and spoke of the objects he had had in view, as follows: "To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction, which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-believe by which pious hands have hidden its uglier features is stripped off."

He died in 1895, at the age of 70, his work done. On

his tombstone there were incribed, by his own request, three lines from a poem written by his wife:

"Be not afraid, ye waiting hearts that weep;
For still He giveth His beloved sleep,
And if an endless sleep He wills, so best."

I might end on this sad note, but to do so would not be in harmony with the moral of the Huxley story. The dominant note of his life was not melancholy; it was vibrant with virile courage, with the essential spirit of true manhood. To the young men in an industrial centre such as Butte, to the graduates about to start on their career as mining engineers, I commend Huxley's life and teaching as a tonic to their moral fibre; it should cause them to appreciate the fact that man does not live by bread alone, and that a bread and butter dependency is not the sole object of education, whether it be scientific or classical. I have quoted his splendid description of a liberal education. He fulfilled his own teaching. He exemplified the workings of a spirit nurtured in the dry bracing air of scientific thought. He was the exponent of veracity in thought and in action; he demonstrated the tremendous value to the community, particularly to a democratic community, in which ideas are freely uttered, of intellectual honesty. The possession to a superlative degree of this quality made him greatly useful in his day and generation; it also made him happy. His was a life joyous in its splendid independence and forcefulness. He had a sincerity of mind that some of us would please ourselves by calling it American. I commend it to you who are about to set out in life as a priceless quality. It belonged to Alexander Hamilton, to Theodore Roosevelt, and to the greatest of all truly great men, Abraham Lincoln. Intellectual honesty is the first requisite of a scientific mind; it is the touchstone of real independence.

"This above all; to thine own self be true,
And it must follow, as the night the day,
Thou canst not then be false to any man."

Aluminum

The expansion of aluminum-plant capacity in the United States has been continued as the development of hydro-electric power near Marysville, Tennessee, and Badin, North Carolina, has increased the power available, states a U. S. Geological Survey bulletin. Experiments of the Anaconda Copper Co., which has been under way for some time at Great Falls, Montana, resulted in the production of aluminum early in 1921, though not on a commercial basis. It is reported that a San Francisco company has under contemplation the development of an extensive water-power on Klamath river which is to be used for the manufacture of aluminum.

The French aluminum industry has been brought into closer control by the purchase of the Société électro-métallurgique française by the Compagnie d'Alais. The combination, which has a capital of 130,000,000 francs, will control 90% of the French aluminum-producing capacity and has extensive holdings in the Italian and Norwegian aluminum plants. Information is now available concerning the production of aluminum in France for the war period. The official figures are as follows:

Aluminum Produced in France, 1913-1919, in Metric Tons

1913	13,483	1917	11,064
1914	9,963	1918	12,019
1915	6,017	1919	10,255
1916	9,601		

The production of aluminum in Norway in 1919 was 3120 metric tons, as compared with 6834 tons in 1918 and 7600 tons in 1917. The aluminum works of Norway are the Tyssedal and d'Eydehvn plants of Det Norske Nitrit Ak, the Hoyang plant of the Norsk Aluminum Co., and the Vigeland and Stangfjord plants of the A/S Vigelands Brug. The experiments of the Norsk Aluminum Co., in connection with the extraction of aluminum from labradorite, have not yet met with commercial success.

The probable annual capacity of the German aluminum industry is between 25,000 and 40,000 tons, probably nearer the lower estimate. A large part of the German industry uses lignite for power, which would hardly seem to warrant the belief that it can long survive a return to more normal conditions. The war contract of the German government for aluminum with the Swiss Aluminum Industrie A. G., of Neuhausen, was finally canceled by payment of 11,000,000 Swiss francs to the company. The production of aluminum in Italy in 1919 was 1673 metric tons, as compared with 1715 tons in 1918.

The economic conditions in Mexico are summarized in a consular report as follows:

(1) A refunding of perhaps $75,000,000 of defaulted bonds, plus some $30,000,000 of accrued interest, a funding of foreign damage claims of at least $50,000,000, and a substantial increase of the net revenues of the Government, to provide service on all this, are essential for the near future. The currency system is dangerous in its rigidity, but steps are being taken to reform it.

(2) An almost complete new banking system has to be built, and it is hoped to insert in it desirable features of the American reserve system.

(3) Under existing currency and banking systems, the question of foreign exchange enters little into commercial questions.

(4) The normalization of prices is proceeding more slowly and more irregularly than in the United States. Local manufacturers are prosperous.

(5) Labor is much cheaper in Mexico than in the United States, but readjustment is yet taking place in most lines. Unemployment is serious. There remains danger of disaster from radical agitation, but it is diminishing.

(6) Production costs have not yet been fully adjusted, and tariff action may tend to hold them up.

(7) All trade is dull, and the condition will be corrected only by an improvement in world commodity markets and greater confidence in the maintenance of stable government.

Status of the Metal Mining Industry: An Interrogatory

In order to obtain trustworthy information on the present status of mining, the business department of the 'Mining and Scientific Press' recently issued an interrogatory to a number of engineers who are qualified to testify on the subject. The following sent answers:

Walter H. Aldridge	E. A. Julian
Charles Bocking	John G. Kirchen
F. W. Bradley	P. C. Knapp
L. S. Cates	Robert Linton
J. Parke Channing	William J. Loring
Charles A. Chase	W. G. McBride
David Cole	Seeley W. Mudd
George E. Collins	J. Nelson Nevius
M. J. Dailey	William A. Ogg
James S. Douglas	W. B. Phelps
Walter Douglas	L. D. Ricketts
Karl Eilers	George A. Stahl
A. B. Foote	George W. Starr
Daniel C. Jackling	George M. Taylor
Sidney J. Jennings	Arthur Thacher
Ira B. Joralemon	Benjamin B. Thayer

H. I. Young

It will be seen that the list is thoroughly representative. We are not at liberty to publish the letters as received from these gentlemen, but we give their replies seriatim, feeling sure that the information is timely and interesting.

GOLD

Question 1: Is gold mining expanding by reason of the general lowering of the cost of production?

"Yes, slowly and gradually in the Cripple Creek district."

"Yes, but very little. Decreased cost of production is too little to have had effect."

"Not to our knowledge."

"No. I see no signs as yet of any revival of interest in gold mining either as concerns the development of new properties or the bringing into production of gold mines already developed but idle."

"There has been some expansion, due to a general lowering of cost of material and labor, but it is my belief that the chief cause of interest shown of late in gold mining is due to a stagnation of the base metals market. Those that have been driven from the base metals are seeking other fields; oil for some time absorbed most of this interest, but at present some interest is being turned to gold mining. The slight reductions in mining costs are not large enough to make gold mining attractive. In fact, my costs are higher than at any time during the history of the mine. This is due partly to conditions in the mine itself; but mainly due to high freight-rates which greatly affect our costs of power."

"No; with the exception that in the Cripple Creek district there is some increase in tributing, due to work being unobtainable in other lines."

"I do not know that I can say that the expansion of gold mining has been apparent yet. There seems little doubt, however, that the gradual reduction in cost of operation will cause such an expansion. Another reason for expansion will probably be the fact that in the future money will be more plentiful for such work, because the profits to be derived from industrial work have decreased and capital will be seeking the greatest return and will probably be attracted by the possibilities of mining."

"The —— mine is resuming operations in full, after operating at less than 50% for 16 months, although costs are still 30% above 1914."

"To date there is no apparent expansion, but I believe that the next few months will show a slight improvement in this direction."

"Yes—prospecting."

"Some new work has actually started, and there is much conversation concerning plans for future work, most of which may not be carried out unless further substantial reductions occur in operating costs."

"Yes."

"The only strictly gold camp that I am now at all familiar with is Cripple Creek, and there gold mining is expanding, by reason of general lowering of costs of production."

Question 2: Have the gold mines in your district that were shut-down by reason of high operating costs during the War period resumed activity?

"Yes—to a moderate extent."

"No. Only four mines worked on company account during the War. Reports are that one company, the ——, is to resume on September 1. Otherwise, not a single property has opened since the War, except a few in a desultory way by lessees."

"No."

"None of them has resumed."

"Up to the present writing none of the properties in this district that were closed down due to high operating costs has resumed operations. Costs have not been greatly reduced, although labor has been reduced $1 per shift for all classes. Our main item tending to high costs is the production of power. Freight reductions would help us more than anything else."

"No."

"No productive mines have been shut-down so far as I know. The amount of prospecting and developing has decreased, however."

"Some of them."

"No."

"Not generally."

"During the War this office closed four gold properties, due to a combination of high costs and constantly decreasing value of ore. The daily gross production was, roughly, as follows:

A—700	tons	@	$9	per	ton	$6300
B—400	"	"	4	"	"	1600
C—300	"	"	5	"	"	1500
D— 40	"	"	12	"	"	500

"'A' has resumed on basis of 50 tons per day at $15, and 'D' is just started at previous rate, both totaling $1100 per day gross production. 'B' and 'C' have been dismantled.

"One gold prospect receiving development at outbreak of war, was closed and work not yet resumed. Should costs continue to decline, work will be started during the coming year."

"No."

"One silver-gold-lead mine in the Telluride district, the ——, is attempting resumption. It is presumed to have shut-down because of generally adverse conditions."

Question 3: Should the McFadden Bill fail to pass, will it seriously affect gold mines and militate against prospecting and development of new properties?

"Yes, I certainly think so."

"Yes."

"No. Passage of this bill would temporarily stimulate but not build up the industry. During the War, when prices of everything except gold were artificially raised, it would have been just and equitable to have passed such a law. But now that the worst is over, gold mining will be on a firmer basis if left to pick up gradually, rather than to be given the temporary stimulus of this bill, only to be inevitably followed by reaction that would be disastrous and might become fatal to the industry. The subject is too long to be discussed here, but such 'special privilege' legislation as this is never desirable as a political policy, and the present depression is largely the result of recovery from special privilege laws and conditions during the War."

"If the McFadden Bill fails to pass, it will most seriously affect prospecting, or, I should better say, that the passing of this bill would undoubtedly stimulate prospecting for gold. Also many gold mines throughout the country would again operate if the bill was passed; but the gold miner looks forward more to the reduction of costs than to protection. Freight-rates must be materially lowered for us to exist much longer."

"Yes; unless, as I anticipate, international conditions result in a premium on gold."

"The failure of the passage of the McFadden Bill would leave things as at present. If it should pass there would be a very marked increase in prospecting and development of new properties."

"We are not counting very much on the passage of this bill. We naturally would like to see it passed."

"Should the McFadden Bill fail to pass it would not seriously affect existing gold mines, because to a slight degree the reduction of operating costs will compensate for a part of the benefit that would be derived by the passage of the McFadden Bill and to a very great extent the failure of the McFadden Bill, or some similar legislation having for its purpose the relief of the gold producer, to pass, prospecting and development of new properties will suffer a handicap. In my own particular case, I have opened and ready for stoping a million tons of ore that is not payable under present operating costs, but these reserves would be highly productive if the McFadden Bill or some other legislation were passed to give relief that the McFadden Bill proposes."

"Yes."

"Failure of the McFadden Bill to pass will not affect our plans, since we have never considered it had a chance."

"No, because under present market conditions, speculators would furnish any amount of money for a good gold mining proposition. Gold is in legitimate demand as a standard of value, and this demand should not be 'monkeyed' with or jeopardized by a 'smart-alec' effort to secure a subsidy for the gold-mining industry. In other words, the gold miners should let well enough alone. There are not many commodities that can now-a-days be marketed so easily as gold is marketed."

"The coming months will be more painful, but the ultimate readjustment will be healthier; with a healthy readjustment, I doubt that prospecting will be hurt or that new properties will fail of development."

Question 4: Are the managers of existing properties considering ways and means of reducing operating costs through the installation of more modern and more economical equipment?

"Yes, to as great an extent as possible."

"Yes."

"Yes."

"My observation has been that the *managers* are always seeking ways to reduce costs, but in many cases they are restrained from making improvements by the demand for immediate dividends."

"Managers of existing properties do look forward to a reduction of costs by use of modern equipment, and most gold mines are quite well equipped with modern machinery.

"Actual mining costs, that is, breaking, tramming, etc., as compared with reduction costs (metallurgical) are higher now than in pre-war times. In other words, the main chance for cost reduction lies in the mine rather than in the mill. Gold-bearing veins, with a few exceptions, are narrow and require underground mining methods that are expensive. If large low-grade properties could be found, the chances for low costs would be realized, as has been the case in copper mining."

"They are considering all possible means, but without prospects of material results, excepting in a few non-typical instances."

"Always, I think."

"We are always looking for improvements, but are not contemplating any important installations now."

"I cannot answer for other operators, but in my case I have, in the face of the high cost of machinery during and since the War, installed labor-saving devices which were made necessary for operating during the War period and the high operating cost period. Therefore, so far as my operations are concerned, I know of nothing that could be added that would reduce the cost of operating on my properties except the application of these up-to-date appliances in a more practical way. Each month shows an improvement in costs, mainly due to the co-operation on the part of my various operators to this one end."

"Yes; in every way to save labor."

"Yes. But are frequently limited in installation of more economical equipment, on account of the erratic ore occurrence and the small developed tonnage. This applies particularly to the gold mines of Nevada."

"Yes."

"I hope so; that seems to be their proper function, and should regret to see them recreant as a class."

Question 5: If the answer to No. 4 is 'Yes', please give such particulars as you can.

"Cannot record anything in detail at this time."

"By the substitution of electrical compressors for steam, if in the judgment of the management there is enough ore to justify it; better air-drills and the continuation of the Roosevelt Tunnel for drainage of the Vindicator group."

"Investigating improved gold-saving devices for dredges."

"Am not in touch with any activity in gold mining."

"I believe I have answered No. 5 under No. 4. I might add that large-scale production and consolidation of management would help a lot."

"An answer to this question depends so entirely on the circumstances concerning each individual mine that an adequate reply would occupy a volume."

"I know of no particular directions in which special effort is being made now."

"'A' has over one million tons of low-grade tailing that should yield a profit if cheaply handled. It is now equipped with a Radial wire-rope tramway, which cannot give desired capacity of 1000 tons in 16 hours. It is expensive in operation, and fails to efficiently clean the bottom layer without dilution with waste. The installation of other equipment is now being considered that will

more efficiently convey the tailing to the treatment plant already erected."

"Every operator of a profitable gold mine is on the alert to reduce operating cost and to increase metallurgical efficiency."

Question 6: What class of mining and milling machinery is least satisfactory in the performance of its function and in what respects should it be improved?

"This is too large a question to answer in a letter of this scope."

"In mining, better and cheaper air-drills. In milling, better and cheaper grinding-machinery."

"Does not lend itself to an easy answer from dredge operators."

"Power-generating machinery is the least satisfactory, though the trouble is often due to poor installation and poor attention to it while operating. There is room for improvement in power-generating machinery, both for efficiency and cost."

"In the mining end, improvements could be effected on mucking-machines, dust-allaying stoping drills, and ventilating-equipment and methods. In the mill, breaking and grinding-equipment, as most gold mines have to do fine grinding."

"Milling machinery is the least satisfactory in the performance of its function. This requires explanation. The simple act of crushing ore to a fine powder may be done in any sort of a grinding or stamping apparatus, and so long as there are no impurities mixed with the ore crushed it makes little difference what type of machine may be used, metallurgically, but economically, milling machinery should be such as to treat the largest tonnage per unit of crushing-plant, whether it be stamps, rolls, or ball-mills. For instance, my —— mill is averaging nearly 19 tons per stamp. This has been made possible by the introduction of modern grinding-plant after the stamps, which was less expensive to erect and is less expensive to operate than the old type of stamp-mill that has been used in the past and is being used at the present time in various sections of our country.

"Another vital question that should receive attention is the rock-drilling plant on the mines. Efficient air-compressors sufficiently large to force air the required distance with the minimum of friction, minimum of loss through leakages, and the application of compressed air at economic pressure in the operation of a machine-drill of the latest type, should be installed. There are several that are not over three years old, and one or two that are not over a year old, that are certainly nearly the last word in drilling-machinery. Ventilation should be carefully watched, but in order to answer your question No. 6 fully it would be necessary to write at considerable length in order to point out the numerous departments of a mine that should receive detailed attention. They do not amount to a great deal singly, but collectively they mean considerable in the direction of operating costs, but I do not take it that this is what you are asking for."

"The shovel."

"Where mining and milling are dependent upon power from internal-combustion engines, the delays due to engine trouble may constitute the chief source of loss through decreased production and higher costs.

"Manufacturers are satisfactorily improving these machines, but they should more carefully ascertain the conditions under which their engines are to operate, and, in some instances, lower the horse-power rating so that overloads may be avoided.

"Dilution of ore in mining continues to be a large factor in raising costs through decreased production.

"Surface sorting aided by washing-machines would help many small gold mines. Present machines are bulky and expensive to operate, but, clumsy as they are, small operators are not fully educated as to their value.

"In cyaniding gold ores there are heavy losses in chemicals and soluble values, accompanied by high costs in dissolving and filtering.

"There appears to be special need for a machine that will satisfactorily combine the work of agitating and filtering."

"Ball-mills for a hard-rock low-grade gold-quartz mine. Such mills should be thrown out and replaced by stamps."

"The dry-stoping drill is heinous and its continued use will destroy present users and prevent proper recruiting for the industry in the future. Wet drills are developing slowly, but it may be necessary to compel their use."

Question 7: Is there a tendency to substitute mechanical for hand labor wherever possible and for what particular class of work?

"Yes—for tramming."

"Yes, of course, wherever possible, but the changes are so small from time to time that are possible to make, that it is hard to give particulars, outside of mechanical mucking-machines in the mines, and in milling we substitute everything new that comes up and is proven efficient."

"No."

"Not so much as in manufacturing. The mill is carefully designed to reduce hand labor to the minimum, but

the mine is neglected in this respect. It is rare to see a gold mine of any size in which there is not room for more mechanical methods of handling ore and waste underground.

"I think that the strong tendency of mining to fall into the hands of a few big operating companies, and the waning lack of interest on the part of the little fellow to take up and develop prospects is an unwholesome tendency in our national life. It is the reason for the fading out of the prospector."

"There is a tendency to substitute mechanical for hand labor and the greatest possibilities lie, in my opinion, in the development of mucking-machines. These machines must be small, light, and efficient; must be designed to be used in stopes, as many gold mines have to use a filled-stope method of mining, which requires a great deal of shoveling. Drag-line scrapers with small air-hoists have proved a great aid, but it is my opinion that a small, light, portable mucking-machine could be developed."

"Yes; all places. With mines of short life the difficulty is one of investment and the time required for its repayment through economies."

"We always are trying to eliminate hand labor."

"This is a most difficult question to answer, because the well-regulated mine, under close management, has in the past introduced mechanical for hand labor wherever possible and there is no more tendency at the present moment than there has been in the past to do this.

"I do not think it out of place to state here that a mechanical shoveling device, made cheap and light enough to be used in ordinary drifts where from 30 to 50 tons of muck is broken per 24 hours, which machine could be wheeled around on the ordinary car-track from one place to another, would fill a great want and expedite not only the development work but at the same time reduce the cost of this particular type of work.

"The great trouble is that all shoveling machines are too expensive, too cumbersome, and too heavy to be considered under the headings referred to above. A mechanical shoveling machine, such as the one I have referred to, would find a large field for operation, but the great trouble is that inventors are too elaborate in their ideas and too little attention is given to the economic side of the question to have provided up to the present time a machine that will serve a long-felt want, that is, in handling a small amount of muck broken from the face of a drift whose cross-section represents 6 ft. 6 in. by 7 ft. in the clear, with an advance of probably 4 ft. 6 in. per 24 hours. This is the type of machine we want."

"Shoveling."

"Yes, at every possible point, depending upon the capital expenditures required and the ore-reserves over which such expenditures can be spread."

"Yes. For all classes, where opportunity offers."

(To be Continued)

Chromite

The only commercially valuable ore of chromium is chromite, states a U. S. Geological Survey bulletin. As the chromite in commercial ore is mixed with other minerals the ore rarely contains more than 55% of chromic oxide, and most of the ore now marketed contains about 50%. Chromium has many uses, largely as a constituent of chrome-steel. The chromium is introduced into the steel as ferro-chrome containing usually between 60 and 70% of chromium. A corrosion-resisting chrome-steel contains from 11 to 14% of chromium and not more than 0.45% of carbon. It strongly resists rusting and all forms of oxidation, even at high temperatures, and it is not corroded by many agents that attack ordinary steel, nor is it affected by nitric acid, though it is attacked by hydrochloric or sulphuric acid. Salt water, fruit juices, and ammonia have no effect on it. Although invented by an American, it was first used in England for cutlery. During the War it was used extensively for making the valves of internal-combustion engines, for which it is particularly suited, not only because it resists pitting but also because it retains its strength at high temperatures. Its physical properties are equal to those of ordinary steel and in some respects superior. The War delayed development because of the lack of chromite, but the use of the alloy should be increased materially, even in connection with structural work. It is usually known as 'stainless' steel.

Stellite is essentially an alloy of cobalt and chromium, to which is usually added a small quantity of tungsten to increase strength. Its composition varies as follows: Cobalt, 50 to 60%; chromium 30 to 40%; tungsten, 8 to 20%. It resists corrosion. Its hardness persists at high temperatures; during the War it was used in high-speed lathe tools employed for turning shell and ordnance. It is extensively used in the manufacture of surgical and dental instruments. Chromite is used as a refractory material, principally in the steel industry. It has been estimated that about 1½ lb. is consumed for each ton of steel made. Small quantities of chromite refractories are used in certain parts of furnaces for smelting copper and nickel. The chemical industry consumes a large quantity of chromite in making chromates and bichromates of soda and potash, and chromic acid. Before the War the tanning industry consumed about two-thirds of the chromium chemicals, but during the War the proportion was reduced to about one-half. In dyeing textiles chromium salts are used as mordants. The cloth is saturated with the mordant and then introduced into a bath of the coloring matter where a precipitate (lake) is formed on and in the fibre of the cloth. Chromium compounds are also used as pigments.

SIGNIFICANT PURCHASE OF COPPER

The American Brass Co. has purchased approximately 5,000,000 lb. of copper for October and November delivery at 12⅜c. and has put out another inquiry for several million pounds additional at the same figure. The order for the 5,000,000 lb. went to several dealers, being distributed equally according to the importance of the selling interest and the ability of the seller to supply the metal when wanted. In the trade it is said that not all the dealers took part in the transaction and some are insisting that the American Brass Co. will find it impossible to secure much more of the metal at that figure. As a matter of fact virtually all the big sellers are quoting 12⅜ to 12½c. for October delivery with a slight advance for later shipments and the fact that the American Brass Co. on the new inquiry wants November and December delivery is believed to be the reason that it will find difficulty in obtaining the metal at this figure. Several of the large sellers are unusually firm in their attitude on prices, and it is known that at least two refused to take any of the recent business of the American Brass Co. because they considered the price unsatisfactory. The American Brass Co. is the first of the large consumers to be in the market in months with the possible exception of the American Steel & Wire Co., which was a purchaser two months ago.

BETTER PRICE FOR SILVER HELPS THE MINES AT COBALT

Eight mines are producing silver in the Cobalt district. In the order of their importance, they are the Nipissing, Mining Corporation, Coniagas, O'Brien, La Rose, Bailey, Aladdin-Cobalt, and Hudson Bay. The increase in the price of bar-silver to close to 70c. per ounce in New York, which is equal to about 77c. in Canadian money, will cause a number of other mines to resume production provided the price shows reasonable signs of remaining at this high point. Among the present idle properties which could operate profitably with silver at 70c. per ounce are the Temiskaming, Beaver Consolidated, McKinley-Darragh, and possibly the Peterson Lake. Costs at the Nipissing have been reduced so as to average less than 35c. on each ounce of silver produced. This indicates a net profit of about 40c. per ounce on current output. The company will disburse a regular quarterly dividend of 3% on October 20 and with a surplus of close to $4,000,000 is expected to pay a bonus of 3% with its January disbursement, as has been the custom in former years. High-grade ore being taken out of the O'Brien, Nipissing, and the Violet mine of the La Rose company compares favorably with the rich shoots which attracted widespread attention to the Cobalt district 15 years ago.

MINE TAXATION TO BE DISCUSSED AT THE MINING CONGRESS CONVENTION

Believing that a thorough discussion of taxation of mines by the various States—(1) existing laws, (2) principles, and (3) uniformity—by representatives of State governments and representatives of the wasting industries will serve a useful purpose, this subject has been selected by the Committee on Taxation for consideration at the Mine-Tax Conference to be held under the auspices of the American Mining Congress at the convention to be held in Chicago from October 17 to 22. Invitations have been sent to the Governors of all the States to appoint special delegates to attend this conference, and the conference is open to all others interested in mine-taxation. Members of the American Mining Congress are urged to take up with the Governors of the States in which they operate the matter of having delegates appointed for this conference, which has for its primary aim the discussion and refinement of methods which will equalize, simplify, and lighten the growing tax burden, and thus stimulate the mining industry.

UNITED STATES SMELTING DECLARES REGULAR DIVIDEND ON PREFERRED STOCK

The United States Smelting Co. declared its regular quarterly dividend of 87½c. per share on preferred stock, payable October 15. The directors issued the following statement:

"Consolidated earnings for the first eight months of this year are estimated at $1,314,260 after providing all interest. There have been deducted from these earnings reserves of $700,633 for depreciation and depletion and $97,515 for further exploration work in Mexico. These reserves aggregate in all $798,148 and leave estimated net earnings for the eight months of $516,112, of which $281,498 was earned in the half-year ending June 30. The preferred dividend requirements for the eight months period are $1,134,816. In June and July, operations in Mexico were curtailed owing to decreased power-supply resulting from lack of rain, but these conditions are now improving and with increased tonnages and a somewhat higher price for silver the Mexican earnings are more satisfactory. The Bingham mines in Utah have continued operations steadily throughout the period and, notwithstanding the low price of lead, have earned enough to provide the usual reserves for depreciation and depletion in addition to showing a moderate net profit. The Midvale smelter and the lead refinery have continued operations at a reduced tonnage owing to the shortage of custom ores due to high mining, transportation, and smelting costs and the low price of metals, and until these conditions are bettered the operations cannot be considered as satisfactory. All metals are carried at 'market' and if the present moderate improvement in operating conditions continues for the next four months the company should end the fiscal year with but a moderate decrease, if any, in surplus after deducting full charges for depreciation, depletion, exploration, and the payment of the preferred dividend."

COMPLAINT AGAINST MINERALS SEPARATION IS AMENDED

The Federal Trade Commission has amended the complaint in the Minerals Separation case. The amendments do not vitally affect the complaint, being largely changes in construction, and it is generally thought that no additional collections of fact will be necessary. The most important of the amendments is that which charges that the defendants, by virtue of their alleged control of the patents in question, "are able to and do directly affect and exercise a direct con-

trol over interstate commerce" in the case of the ores and metals affected by the patents.

MINING IN UTAH IS BY NO MEANS 'DEAD'

F. C. Schramm, president of the Salt Lake Chamber of Commerce, announces that immediate action will be taken to discount misleading reports that have been circulated broadcast as to the present status of the mining industry in Utah. Mr. Schramm states that owing to the shut-down of the Utah Copper Company, the opinion seems prevalent that the mining industry in this State is in a "very depressed condition". This is far from the truth. He calls attention to the fact that the silver-lead mines in the Park City and Eureka districts are now employing more men than at any time in the past four years; that Utah is producing more silver than any other State in the Union, and still retains its place of being third in the production of lead. The Murray smelter is running four out of eight blast-furnaces; the United States smelter at Midvale is operating four out of six blast-furnaces. The Garfield smelter is producing an average of 10,000 oz. silver per day, although, naturally, its copper production is considerably below normal, owing to the Utah Copper Company being closed down. Taking everything into consideration, Mr. Schramm is of the opinion that Utah mining operations, as a whole, are more nearly normal than those of any other Western State.

LEACHING WITH SULPHUR DIOXIDE PROVES SUCCESSFUL

Tests on leaching with sulphur dioxide complex ores from the Miami district in Arizona have been completed at the South-West station of the U. S. Bureau of Mines at Tucson. It is considered that sulphur-dioxide leaching is a demonstrated success on the most refractory silicious ores in the South-West and also on ores containing a large percentage of acid-soluble gangue. The commercial application of the process appears to hinge largely upon the successful development of the manufacture of sponge-iron. Laboratory work is being done on Walker River silicious copper ore, which has soluble lime, iron, and manganese aggregating 10% acid-soluble gangue. The results obtained so far are encouraging.

IDAHO PREPARED TO ASSIST PROSPECTORS

Stewart Campbell, State Mine Inspector for Idaho, has added a new feature to the office that will add materially to its value to the prospector and the general public. A prospector must know the value of and the market for the ore or mineral sought or found, and as there is no convenient source available where he can find a marketing place for any of the uncommon ores or minerals, Mr. Campbell has prepared a complete list of the purchasers and users, in the United States, of the following metal and non-metal products, all of which are found in Idaho: Antimony, barytes, bauxite (aluminum), bismuth, cadmium, chromium (chrome ore), cobalt, diatomaceous earth, feldspar, fluorspar, fuller's earth, graphite, gypsum, magnesium, magnesite, manganese, mica, molybdenum, nickel, platinum, pumice, radium, silica sand, sodium, talc, tin, titanium (rutile), tripoli, tungsten, uranium, and vanadium. Information concerning the purchasers or users of any particular mineral will be furnished on request to his office. With this information and the services of the Idaho Bureau of Mines and Geology, at Moscow, available for a qualitative determination of unknown minerals, the State has opened two avenues of assistance leading to the development of her mineral resources.

LOCAL SECTION OF THE INSTITUTE ENTERTAINS H. FOSTER BAIN

The Local Section of the A. I. M. & M. E. gave a dinner and smoker in honor of H. Foster Bain, Director of the Bureau of Mines, on October 4. Mr. Bain and the members of his party, who are visiting the mining States of the West, spent three days in San Francisco and Berkeley, where the Bureau has an experiment station.

ARIZONA

Jerome.—At a recent meeting of the Arizona Chapter of the American Mining Congress the following resolutions were adopted:

Taxes

Whereas, a grave situation faces the mining industry from all angles, in that the present selling price of copper is 4c. per pound less than the average selling price based upon 10 years previous to the great war; that practically every cost attached to the mining industry has risen to a height entirely inconsistent with pre-war conditions; that the burden of taxation within the State of Arizona has become so heavy by reason of the tremendous expenditures being made for public purposes, resulting in the net cost for the taxation alone of 1.7c. upon every pound of copper produced; and

Whereas, if the present burden of taxation is maintained or increased, as seems to be the prospect now before us, there is grave danger that this factor of itself will prevent or greatly delay the resumption of mining operations, even under more favorable industrial conditions than are now present; now therefore be it

Resolved, that efforts shall be made by those interested in the mining industry to bring before the taxpayers of the State the serious problems now confronting the State, and endeavor in every way to influence all the boards or other officers having jurisdiction in the matter of public expenditures and conserving the money of the taxpayers, to the end that the present excessive rates shall be promptly and materially reduced, and that the present burden of taxation shall be lightened upon every class of property in the State.

Freight Rates

Whereas, the resumption of mining copper depends upon the sale of the product at a profit, and,

Whereas, the large items of expense in cost of production and marketing are freight-charges on mining machinery, material, and supplies, freight on ores to smelters and copper bullion to refineries, now therefore be it

Resolved, that this Congress notify the carriers serving the mining industries of this State that before it will be possible for the mining companies to resume operations it is imperative that the cost of transportation be materially modified.

Kingman.—No. 3 shaft of the United Eastern Mining Co. has reached a depth of 674 ft. The shaft is to be carried to the 800-ft. level, from which point cross-cutting and drifting on the vein will be done. The new tram to the mill from the Big Jim workings is almost complete. August production of the company was 8400 tons having a value of $169,-122, yielding a profit per ton of $12.25.——A winze is now being sunk to the 1000-ft. level in the orebody recently found in the Oatman United mine. The vein was discovered on the 600-ft. level by diamond-drill work; it is now being opened by drifting. At this level the ore shows a width of 30 in. with gold content as high as $105 per ton. A contract has been let for 3000 ft. of diamond-drilling.

The United American Mining Co., whose property is at Oatman, has made application to the Corporation Commission for a permit to sell 223,925 shares of stock at 20c. per share. Heretofore most of the stock has been purchased by local people. The main shaft of the mine has been sunk to the 700-ft. level, where some development work was done. There is ample machinery to carry on further work. A winze is now being sunk on the body of ore found in the Aztec vein, which has been opened on the 400-ft. and 600-ft. levels.

Ray.—Foreclosure proceedings against the Arizona Hercules Copper Co. have been started by the Empire Trust Co. of New York in the Superior Court of Pinal county. The suit is brought to foreclose a trust-deed given by the defendant company to the plaintiff to secure the issue of bonds in the aggregate of $3,000,000. The mortgaged property includes mining claims situated in the Mineral Creek district, together with all water-power, water-rights, mill-sites, railroad, switches, rights-of-way, and other property. The action is brought on behalf of the holders of the $3,000,000 worth of bonds, which were issued in January 1919. The bonds were to bear 7% interest, payable semi-annually, but at every interest period, it is alleged, the defendants defaulted and there is now due principal and interest. The mines of the company adjoin the Ray Consolidated Copper Co.'s property. The company also owns a mill at Belgravia near Kelvin.

CALIFORNIA

Alturas.—The Goose Lake Gold Mining Co. has found cinnabar ore. The deposit is said to average 3% mercury.

Darwin.—The Darwin Silver Co. has applied to the Federal Power Commission for a license to construct a transmission-line from the main high-tension line, owned by the city of Los Angeles, to its mines.

Forest.—The new Kate Hardy mill is now in operation. High-grade ore from the upper levels is being stamped. A new adit will be driven to cut the ore-shoot at greater depth.

Georgetown.—Litzenburg & McAllister have received two truckloads of machinery at the mine that they are opening on Travis creek three miles south of here.—R. G. Dougherty and Frank Drew have erected a 30-ton mill at the mine that they have leased on Slate mountain. Former lessees took out $30,000 a few years ago.

Grass Valley.—It is reported on good authority that the interests that control the Metals Exploration Co., owners of the Idaho-Maryland mine, are behind the project to develop water-power in Plumas, Sierra, and Nevada counties. The Yuba Development Co., directed by Bulkeley Wells and Harry Payne Whitney, of New York, will advance $25,000,000 for the construction and equipment of six power-plants, the principal ones being at Nelson Point, Crooked Bar, and Bean Creek. It is estimated that 200,000 hp. will be generated.

Jackson.—The monthly meeting of the Mother Lode mine superintendents was held on September 22 at the Argonaut mine. An inspection of the underground workings formed part of the program.

Natoma.—The California Dredge Operators Association met here on September 27 as guests of the Natomas Company of California, for which L. D. Hopfield is manager. Thirty-two members and a number of guests from the San Francisco section of the American Institute of Mining Engineers were present. The program for the field meeting during the day started with a visit to the Fair Oaks rock-plant. This plant has a capacity of 3000 tons of sized rock that is used for road material and for concrete aggregate. The old dredge-tailings that supply the material are excavated with steam-shovels. After a luncheon at the Citrus hotel, three of the dredges of the Natomas company were visited. No. 9 dredge, built with a wood hull in 1911, was sunk a few months ago. The pond has been pumped out and the dredge dismantled. The machinery is being moved by means of caterpillar tractors and trailers and by means of motor-trucks to a site near-by, where a new steel dredge will be erected. At the meeting in the evening the question of sampling dredge-ground was discussed. Chas. W. Gardner read a paper, in which he showed that the actual recovery in dredging frequently was as low as 50% and as high as 150% of the 'expectations' as indicated by sampling with churn-drills. He emphasized the fact that prospect-drilling could not be done accurately and that the judgment of the engineer in interpreting results was the most important factor. R. G. Smith, engineer for the Natomas company, discussed the sundry sources of loss in dredging. Sampling of dredge-tailing is a difficult procedure, but his company is making a study of the various sources of loss that may account for the discrepancies between the expected and the realized recoveries.

Placerville.—Joseph Morovitz is developing the Fairchild gravel mine. He has found a pay-shoot but has not yet determined the extent of it.

COLORADO

Breckenridge.—Farncomb hill, famed for its wire-gold discoveries, but long neglected, is again the scene of activity. The Pontoon and Gladstone lodes, at the head of American gulch, the Key West and Fountain, the last named owned by the Campion estate, are all being operated under lease.

Central City.—The modern electrically driven plant at the Frontenac is to be duplicated at the Adubbell shaft by the Eastern syndicate that recently took over the Frontenac properties. The Adubbell will be connected with the Lowe raise from the Newhouse tunnel, thereby affording both ventilation and drainage of the mine workings.——The Midwest Mining Co. reports progress with the adit to drain the Cyclops workings to a depth of 400 ft. The company is mining a good grade of ore in the Alaska and Peru. The Alaska, two miles distant from the Cyclops, is producing silver-lead ore sampling 75 oz. silver and 10% lead. The ore is treated at the Iron City mill at Blackhawk, controlled by the company.

Cripple Creek.—The Cresson continues heavy production. Thirteen cars were loaded out Monday and the minimum daily billing of the week has been nine cars.——The Ajax Mines Leasing Co. is now shipping steadily to the Independence mill of the Portland company, near Victor.——George M. Taylor, for the past 20 years general manager for the Portland Gold Mining Co., has resigned and Tom Crowe, superintendent, is in temporary charge.

Idaho Springs.—The Golden Edge property on Seaton mountain is again active; new equipment has been installed at the shaft and development on an extensive scale is planned.——New track has been laid in the Empress tunnel of the Empire Consolidated company at North Empire preparatory to extending the tunnel.——The Nelson brothers mill on Silver mountain is operating steadily; the plant is making a good grade of concentrate.

Montezuma.—The St. Johns property controlled by a British syndicate that ceased operating during the War has been leased to local and Denver men. The property was one of the early producers of Summit county.——The Pennsylvania operated by the Liberty Mining & Reduction Co. is producing steadily and the mill is turning out around 20 tons of high-grade concentrate daily.

Silver Plume.—Properties of the Chasfield M. & M. Co., operated under lease by the Silver Gem Mining Co., through the Gold Belt tunnel, are producing a good grade of both smelting and milling ore. On the Sea Gull vein a streak 6 to 8 in. wide is sampling $250 per ton.

IDAHO

Coeur d'Alene.—A second furnace is to be blown-in at the Bunker Hill & Sullivan smelter. The increase in capacity is made possible by a recent accumulation of ore from the mines of the Coeur d'Alene region and the favorable freight-rates from British Columbian points, recently established. The Bunker Hill & Sullivan mine will be in a position to contribute more ore to the smelter through developments in progress on a new level 1400 ft. below the Kellogg tunnel.

Production from the mine is now 1200 tons per day. The new East mill, nearing completion, will have a daily capacity of 5000 tons. The Bunker Hill company shipped 100,000 oz. of silver to the United States Mint at San Francisco and $11,000 in gold to the United States Assay-Office.

An option on the stock of the Hill Mining Co., in Slaughter House gulch, adjoining the East Caledonia on the east, has been secured by Patrick Brady and W. J. Stratton. A vein 4 ft. wide, containing 4% lead and 6 oz. silver per ton, has been intersected by a cross-cut at a depth of 200 ft. The vein will be followed and negotiations will be opened with the East Caledonia for permission to explore the Hill ground from the 400-ft. level of the East Caledonia.——Lessees operating on the property of the Western Union Mining Co. shipped ore having a gross value of $54,445 between November 19, 1920, and August 18, 1921. The net smelter returns were $35,725 and the royalty to the company was $8932. Four sets of lessees are now at work.——The Columbus Mining Co. has received a new compressor, which will be installed on its property on Eagle creek. The plant will be ready for operation by October 25.

The Ajax Mining Co. will drive a new tunnel near Burke, according to A. C. Bixby, manager. A compressor and other machinery is being removed from the Moonlight tunnel. The tunnel to be driven will attain an additional depth of 500 ft. below the workings in which ore was disclosed.——J. W. Buchler, manager for the Silver Reef Mining Co., reports that the company will soon commence development through the lower tunnel of the Homestake mine. The Silver Reef has secured an easement to use this tunnel. By extending the tunnel about 900 ft. an additional depth of 1100 ft. will be secured, gaining a total depth of 1700 ft. below the surface. In the present tunnel, Buchler reports a shoot 887 ft. long, sometimes 12 ft. wide, with high-grade ore on one wall.

Fairfield.—The concentrating plant of the Walton Mines Co., which is operating a property in the Smokey district, is reported to be nearly ready to begin operations. The plant will have a capacity of 50 tons daily. The ore to be treated, of which there is said to be 10,000 tons, with a value of $18 per ton, is a silver-lead sulphide with a high gold content. Mining costs in this particular property, it is said, will be low due to the manner in which the ore has been opened up and to the fact that but little snow is expected.

MICHIGAN

Houghton.—Quincy should be one of the first of the Lake mines to revive when normal conditions in the metal market return. Not only is development at depth in all shafts satisfactory, but improvements at mine, mill, and smelter have effected notable economies. The new hoisting arrangement at No. 2 and 8 shafts, the installation of re-grinding units in the stamp-mill, and the completion of the new furnace and automatic handling devices at the smelter will contribute largely to a lowering of costs when normal operations are resumed. The re-grinding installation alone was responsible last year for the recovery of nearly 2,500,000 lb. of refined copper. Quincy is fortunate, too, in having its own railroad and is not subject to the high haulage charges paid by some of the other mines of the district. No change in Quincy's present policy is contemplated, despite rumors to the contrary. Although failing to 'break even' at the present price of copper, Quincy is holding an organization together and will continue to operate on a 50% basis throughout the winter.

Mohawk continues to work to the capacity of its stamp-mill. A full program of mining and development is under way throughout the mine, with little or no change from day to day in output of 'rock' or yield of copper per ton. Daily 'rock' shipments average about 2600 tons, while the yield is approximately 23 lb. of refined copper to the ton. Mohawk is now sinking, drifting, and stoping in No. 1 shaft and some particularly good ground is being opened north of the shaft.

Copper Range 'rock' is a free-milling amygdaloid, susceptible to fine grinding. The loss per ton is about 5 lb., but this can be reduced another pound by re-grinding. Copper Range is convinced that the solution of its problem is finer grinding rather than leaching or flotation. Even if flotation could be successfully applied it is believed it would be too expensive to undertake because of the relatively small metal content of the sand and the large outlay that would be required for equipment and handling.

All but one of the stamp-head units in the Quincy mill have been supplied with complete re-grinding equipment. As a result, Quincy last year recovered nearly two and a half million pounds of copper that otherwise would have been lost.

NEVADA

Arrowhead.—The Arrowhead company has been refinanced in New York and San Francisco, according to reports, and the shaft is to be sunk to 600 ft. immediately with the money obtained. The shaft is now 330 ft. deep. It is planned to build a mill if the ore-shoots are found to continue to 600 feet.

Cuprite.—The Super-Silica Corporation, formed nearly a year ago to mine and mill silica near Cuprite, has been refinanced and work is to be resumed. The main trouble in the first attempt of the company was lack of adequate power and milling facilities, but this has been remedied by the purchase of a 50-hp. oil-burning engine and a 6 by 22 Hardinge silex-lined pebble-mill. The mill is expected to produce one ton per hour of 400-mesh material, which will mean a good output of 'air-float' in addition to that drawn off the crusher and screens. The plant will be in charge of Ernest C. Wood.

Divide.—The Tonopah Divide is earning $5000 to $10,000 monthly, according to H. C. Brougher, president of the company, who says that after water has been developed a mill will be built. Mr. Brougher said that the ore now exposed in the mine and that on the dumps was ample to justify the erection of a mill and that custom ore could be expected from other mines in the district. He said development work is opening ore considerably in excess of that being shipped. It is said that orebodies have been opened in several parts of the mine that have made a great increase in the ore-reserves.——The Divide Extension is shipping $50 ore to the MacNamara mill in Tonopah at a rate of 900 tons monthly. The ore is coming from stopes above the 200-ft. level.——The Gold Zone continues cross-cutting on the 900-ft. level to open the vein found on the 500 and 700. ——The Brougher, south of the shaft on the 500-ft. level, is drifting on a 1-ft. width of $75 to $80 ore, and it is thought by Gust Hanson, superintendent, that the Divide Extension vein has been found on the 185-ft. level.

Ely.—The shipment of 10,000 tons of blister-copper from the stock stored at the McGill smelter has been announced by C. B. Lakenan, general manager for the Nevada Consolidated Copper Co. The copper will be shipped over the Western Pacific railway in 20-car trains to San Francisco, thence by steamer through the Panama canal to Baltimore. While this is only part of the copper on hand at the smelter, the movement is accepted as an indication that the surplus is being reduced rapidly.

Eureka.—The Bullwhacker, developing through the shaft of the adjoining Eureka-Holly, has driven on the 430-ft. level to a point under the Laird orebody, opened on the 330-ft. level, and has started a raise.——The Eureka-Holly is mining a small tonnage of high-grade ore from two stopes on the 400-ft. level and is driving on the 600 north for the fault beyond which ore was exposed on levels above.——The Uncle Sam tunnel is being advanced and high-grade mill-ore is being broken.

Gardnerville.—On the Veta Grande property, near here, the winze from the lower tunnel has entered the vein, the dip of which changes just below the tunnel level from about 45° to 80°. A working shaft has been started south of the tunnel portal. The vein is, as the name implies, of great size. High-grade ore is exposed for considerable distances in drifts, raises, and winzes driven by later owners. E. J. Roberts is the engineer-manager and San Francisco men control the enterprise, a close corporation.

Leadville.—The main drift on the 300-ft. level of the Leadville mine has broken pay-ore for a distance of 600 ft. The ore is a silver-lead sulphide, containing masses of rich galena that is sacked and shipped to smelters. The ore is treated in the company's 35-ton flotation mill. It passes from the Blake crusher through a Marcy ball-mill and a Dorr thickener, to K & K flotation machines. The concentrate goes to a Dorr thickener and Oliver filter, leaving 8% moisture. Shipments average six tons of concentrate daily, assaying from $200 to $240 per ton. The mill has been treating 30 tons and the new water-line will increase capacity to 35 tons. Extraction of silver is 91.5% and of lead 92%. Power for the mill and mining plant is supplied by two Fairbanks-Morse semi-Diesel engines of 75 and 100 hp. A direct-current generator drives the motors and a 275-cu. ft. Ingersoll-Rand compressor. Homer O'Connell is superintendent.

Log Springs.—A steam-shovel, and pipe, cement, and lumber in carload lots are being hauled from Stonewall Siding, on the Tonopah & Tidewater railroad, to Log Springs for use by Los Angeles interests in placer mining on the Benton-McLaughlin ground, at Log Springs, 45 miles south of Goldfield. A dam has been built for the storage of water, a camp has been built, and it is evident that the placer is to be worked on a good scale.

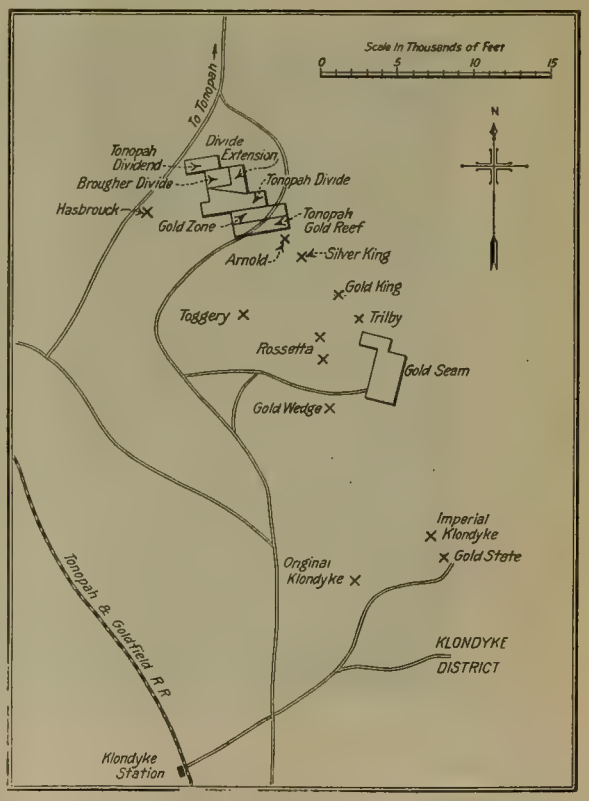
Pioneer.—The Pioneer will soon start driving north-west from the 800-ft., or bottom, level of the shaft, to cut the vein under the old bonanze stopes that extent from the 200-ft. level to the surface.

Reno.—H. Foster Bain, director of the Bureau of Mines, and Marion E. Rhodes, Congressman from Missouri, and chairman of the House Committee on Mines and Mining, addressed a large gathering of mining men, engineers, and attorneys at the Chamber of Commerce while visiting here. Mr. Bain explained the position of the Bureau in connection with the proposed mining bill, now before Congress, advocating its passage. Mr. Rhodes said his committee would not act on the measure before the first of next year. Several members of the audience spoke in opposition to the bill. The only provision in the new mining bill that seems to have any support from Nevada mining men is that repealing the so-called apex law, and many oppose any change whatever. Those advocating the retention of the apex law hold that abuses under this law have been costly only to the large corporations and that proper enforcement of existing laws would provide ample protection to mine-owners, both large and small. Other provisions of the bill have aroused a storm of protest.

Silver Peak.—The mill of the Silver Peak Chemical Co. is finally to be put in operation, according to reports, after several trial runs that were partly successful. It is said that the company has been financed on a scale that will ensure success and that the mill has been perfected. The plant is to produce alum and sulphur from what is said to be the only deposit of water-soluble potash alum known. The deposit, containing an average of 20 to 25% pure potash alum, is practically without limit.

Virginia City.—Surface sampling on the 'middle-mines' group, directed by Albert Burch, has been completed; work is being continued in the Hale & Norcross tunnel, the face of which is within 100 ft. of the hanging wall of the Comstock lode. The Hale & Norcross, Chollar-Potosi, Gould & Curry, and Best & Belcher will be sampled by re-opening old upper-level workings and this work will occupy at least two months. More than 1400 samples were taken from surface workings and dumps. The haulage tunnel of the United Comstock Mines Co. has connected from the portal with the Knickerbocker shaft at a depth of 410 ft. The only remaining stretch is that between the Knickerbocker and Belcher shafts, about 1800 ft. Hoar shovels are driving both headings, making 18 ft. per day. The tunnel, nearly 10,000 ft. long, will be completed by January 1.——The Pittsburg Comstock Co. is opening the old lower tunnel in which good ore is exposed and is laying track. The heading will be continued to cut the Bright Star vein at its intersection with a cross-fracture that has produced high-grade ore from the upper tunnel.

Winnemucca.—The shaft of the Nevada Harmony is reported to be in 5 ft. of $75 silver-gold are at a depth of 200 ft. The shaft has been in ore from the surface and in this and other workings there is said to be $100,000 worth of ore exposed. Sinking was resumed recently at 180 ft. and it will be continued until the 300-ft. point has been reached. George D. Williams is general manager.



Map of Divide District

OREGON

Gold Hill.—In spite of the low price of quicksilver, orebodies in several quicksilver mines in this district are being developed. No furnaces are being operated, however. The War Eagle company, with headquarters at Medford, the largest quicksilver mine in this district, has a crew opening a large body of cinnabar ore, while it is also preparing to spend $15,000 in building a new water-system to supply its plant. Heretofore the mine has furnished the water to operate the mill and furnaces. The War

Eagle mine is equipped with a 25-ton Scott furnace and two 12-pipe retorts for auxiliary purposes.

The Millionaire gold mine, three miles south of here, which was re-opened last season, is operating its mill steadily on a large body of rich ore which was stored for milling some years ago. Ore from a large body in the new works is also being reduced. The main shaft on the mine has been abandoned for the present and the shaft-house and equipment has been re-built a few hundred feet east on the vein. The new shaft has been driven to a depth of 200 ft., and drifting both ways on the vein is under way, but principally toward the old shaft which has a depth of 450 ft. On the completion of the new level connection will be made and the old works will be unwatered and mined.

UTAH

Alta.—Operation of the Little Cottonwood Transportation Co.'s railroad, which hauls ore from local mines to the valley smelters, was suspended for the season on September 24. The company will continue to operate its stage line as long as the weather permits.——Development work in No. 3 raise at the Alta Tunnel property continues to give encouraging results. Recent assays of a 4-ft. strike give gross returns of $70 to $80 per ton, or $55 to $65, after deducting transportation and smelting charges.

Beaver.—Wilford Robinson and James E. Robinson have taken a lease on the old Sheep Rock mines, and will resume operations immediately. It is reported that a vein of mill-ore has been opened that assays about $6 per ton of gold; a second vein gives returns of about $10.40 per ton in gold.

Bingham.—The United States Smelting Co. is developing its mines at greater depth. A shaft has been sunk 200 ft. below the Niagara Tunnel level, which, at present, is the deepest level in the mine and the main haulage-tunnel. D. D. Muir, mine manager, reports that the exploratory work is opening new bodies of good-grade ore. The mine is now producing about 450 tons of ore per day; about 300 men are employed.

Between 500 and 600 men are now employed in Bingham mines, whereas during the War about 4000 employees were on the payrolls. The United States Smelting Co.'s mines employ about 300 men; Utah Copper, 70; Montana-Bingham, 70; Utah Metal & Tunnel, 15; Utah-Apex, 12; Utah Consolidated, 12; Bingham Mines, 10; Bingham-Galena, 10; Bingham-Tooele, 6; and lessees, about 50.

Eureka.—The controversy for the control of the Lehi-Tintic Mining Co. has reached the courts. On September 26, Elias Hansen, judge of the Fourth District Court at Provo, issued an order restraining the Nicholes faction from interfering with the operation of the mine, and ordering Nicholes and his associates to surrender possession of the property. On September 12, Nicholes and his friends attempted to hold a stockholders' meeting and elect their own officers, after which they went to the mine and took possession. Later in the day, the 'official' stockholders' meeting was held, at which Charles Zabriskie, who has been president of the company for the past two years, was re-elected.

Ore shipments for the week ending September 24 totaled 144 cars, as against 161 carloads for the previous week. The Tintic Standard shipped 38 cars; Chief Consolidated, 36; Victoria, 13; Eagle & Blue Bell, 11; Dragon, 8; Iron King, 8; Iron Blossom, 7; Swansea, 5; Bullion-Beck, 3; Centennial-Eureka, 3; Gemini, 3; Mammoth, 2; Eureka Hills, 2; Colorado, 2; Silver Park 2; and Sunbeam, 1.

It is reported that the United States Smelting Co. will undertake a program of development in the East Tintic section. While officials of the company are non-committal, it is said that an option has been taken on the old Addie property. The tunnels and shafts are being cleaned out. This property is situated north of the Eureka-Bullion holdings and in close proximity to the Tintic Standard and Chief Consolidated mines.

Moab.—Lawrence Peachman reports that an excellent showing of gold and copper ore has been uncovered in the Copper Queen property, in the Blue mountains, south of here. Development has been in progress during the past three months, and a shaft sunk to a depth of 70 ft., where a vein was cut. On the hanging-wall side, from 3 to 4 ft. of milling ore is exposed, while on the foot-wall side, ore of smelting grade was found.

H. M. Armstrong, manager for the Keystone Metals Co., operating mining properties near the Utah-Colorado line, announces that a new road, 11 miles long, has been completed, which will make a saving of 20 miles in traveling between Grand Junction and Polar Mesa, where the company's uranium mines are situated.

Park City.—Richard Pelton, superintendent of the Ontario mine, states that 87 lessees are now at work on all levels between the 900 and 1800-ft., all of whom are making better than regular wages. Work is being carried on by the company on the 2000-ft. level.

Shipments of ore for the week ending September 24 totaled 1436 tons, of which the Judge companies shipped 593; Silver King Coalition, 560; and Ontario, 283. Shipments the previous week were 1946 tons.

Conditions are reported as favorable at the New Quincy property. A winze sunk from the J. C. R. drift, from the Little Bell shaft, is now at a vertical depth of about 950 ft. below the surface. The winze has cut from 2½ to 3 ft. of high-grade ore.

Salt Lake City.—The annual dinner of the Utah Chapter of the American Institute of Mining and Metallurgical Engineers was held on September 28. There was a large attendance. The main speaker of the evening was H. Foster Bain, director of the United States Bureau of Mines. Senator Key Pittman of Nevada was also among the speakers. John D. Gray, mining attorney, of the Coeur d'Alene district, acted as toastmaster. While in Utah, Mr. Bain and the members of his party were taken to Bingham to visit the Utah Copper mine. L. S. Cates, assistant general manager, accompanied the party on the trip.

BRITISH COLUMBIA

Alice Arm.—The Homestake group, under bond to the Consolidated Homestake Mining & Development Co., of Vancouver, is being opened by three tunnels. A site has been prepared for a compressor plant, which machinery, together with other equipment, will be shipped in as soon as the snow disappears. Water-power from a creek on the company's property will supply energy.

Anyox.—A vote taken recently by the miners and smeltermen at Anyox as to whether they should accept a further wage-reduction rather than have the Granby company close its plant was strongly in favor of a wage-reduction. The following is the new schedule: first-class metal-craftsmen and carpenters, $4.75; painters, $4.25; miners, $4; shovelers, $3.70; teamsters, $3.55; and outside laborers, $3.15. The company has made a reduction of 25% on the rent of all its houses and reduced the board at its mess-room to $1 per day.

Prince Rupert.—John Wilman, manager for the Kleanza Mountain Copper Co., which has been developing a property near Usk for the past four years, is authority for the statement that the company will erect a modern mill and concentrating plant in the spring, the small Gibson mill now on the property is inadequate to treat the large body of ore that has been developed. According to Wilman, there has been a considerable amount of prospecting within 25 miles of Usk during the past summer, and some promising gold-

copper prospects have been sufficiently developed to allow of examinations.

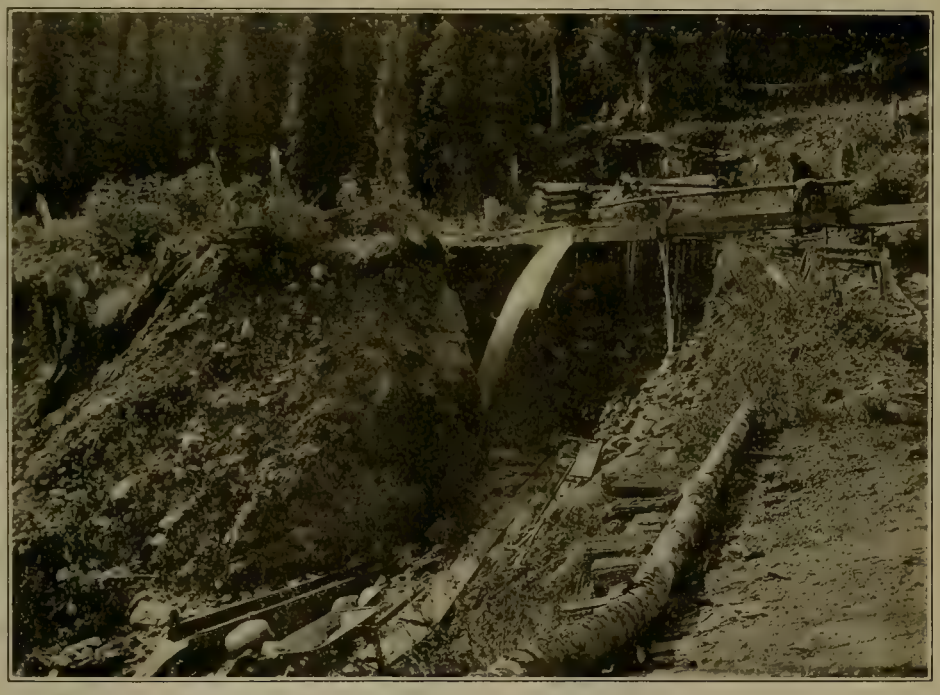
Princeton.—The Kettle Valley Railway Co. is repairing the branch from here to Copper Mountain. Though no announcement has been made that the Canada Copper Corporation's mine and mill are to be re-started, it can be only with this end in view that the railway is being repaired. It is hardly likely, however, that the plants will be re-started before spring, and it is uncertain under whose auspices they will be operated.

Stewart.—The driving of two cross-cuts on the property of the Bush Mines, Ltd., has served to open a large body of ore. This work was done from No. 1 and No. 2 tunnels and the results have proved the soundness of the reasoning of those in charge.——The Lucky Boy group, on Fish creek, the property of Behnsen Brothers, of Victoria, shows promising development.

property. It admits that its free miners' license expired on May 31, 1917, but alleges it was not aware of this until 1918. It charges Alexander with making false affidavits when applying for title and alleges that he, in order to acquire the company's stamp-mill and other machinery, arranged that judgment be obtained against the company in the county court, at Atlin. The company's mill, buildings, and machinery were valued at $20,000 and were sold under process of execution to realize a judgment of $452. The property was bought in by Alexander, who, it is alleged, prevented competitive bidding at the sale by threat. The plaintiff company asks for a declaration that it is the owner of the mine and that Alexander and his associates fraudulently, deceitfully, and unlawfully obtained the Crown grants.

MEXICO

Chihuahua.—Antonio Wilson and associates have filed application before the mining agent at Camargo for the titles to La Fortuna, a group of gold, silver, lead, and copper mines situated in the Morales mountains at San Francisco de Conchos.——Two new denouncements have been filed for record with the Chinipas agency, one by Jacob W. Breach, who has located 10 claims embracing the old abandoned Fernandez Leal mine on the Guasisaco ranch, and the other filing is made by W. D. Howe, who has located the Santo Domingo de la Calzada group of gold-silver properties, consisting of five contiguous claims, adjoining La Reforma and La Prieta mines.



Hydraulicking at Ten Mile, Trout Lake District, B. C.

Vancouver.—Litigation has commenced in the British Columbian courts at Vancouver, the issue of which is ownership of the Engineer mine in the Atlin district. This is admittedly one of the richest lode gold properties of the Province; $1,000,000 has been offered for it on more than one occasion. Action is being brought by the Engineer Mining Co. against J. A. Fraser as administrator of the estate of the late Capt. James Alexander, and others. The history of the mine dates back to 1899, when the claims were located by two Swedes, Charles A. Anderson and Frank Nelson, representing the Aga Gold Mining Partnership. These afterward were taken over by the Engineering Mining Co., an Alaskan company with headquarters at Skagway. Crown grants subsequently were applied for but were refused by the Gold Commissioner and Mining Recorder, doubtless on the ground that the provisions of the law had not been fully complied with. Meanwhile, it is alleged by the plaintiff that Alexander and his partners jumped his claim, re-staked, and eventually obtained Crown grants. The company asserts that it expended $40,000 on development of the

Concencion del Oro.—Silvestre Gonzales, well-known mining man of the Concepcion del Oro district, has recently located a number of new claims containing strong veins of gold, silver, and copper ores. There are two groups, one of two claims to be titled under the name of San Ignacio, and the other, comprising eight contiguous claims, to be patented under the name of Santa Fe. The Santa Fe group is situated near El Favor and La Linda mines in the Temoroso mountains.

Durango.—Gerald E. Norton, who has extensive mining interests in this State, has added 15 new claims to his holdings. The survey will include the old Prolongacion, La Boera, Rosa Maria, and Guadalupe mines, which have been declared forfeited for non-payment of mining taxes. The properties are situated in the San Patricio mining camp in the municipality of Pueblo Nuevo. They are to be titled under one name, La Cubierta.——Jesus Aizpuros, representing Francisco Velez, has applied for titles to El Raton group of ten claims in the Bufa de Inde mining camp, about five miles south of Inde. The new location is surrounded by a number of producing mines such as La Torre, La Natividad, La Fe, and La Mariposa.

El Oro.—An explosion and fire in the interior of the San Juan mines has caused the suspension of operations. One miner by the name of Juan Martinez died from the effects of gas and other miners were entombed within the lower workings. Experts are conducting an investigation of the disaster to ascertain its origin.

Santa Rita.—The Aristeo and La Tajitos mines, which were recently forfeited for non-payment of taxes, have been re-located by Jesus Robledo, who is having the old workings cleaned out. He will sink some of the shafts to a greater depth. The properties are adjacent to the Recompensa and La Purisima mines.

Zacatecas.—Benjamin Cristerna has located the Paloma de Oro group of mines adjoining the Numero 5 and El Bote mines near this city. He is developing a vein of gold ore. ——La Hija del Trabajo, a group of four claims, has been located by Salvador Zajur. The property is situated along the Enciso Arroyo a short distance west of this city. The ores from this new location are similar to those extracted from the Campana de Oro mines, which are situated in the same region.

ONTARIO

Cobalt.—The annual meeting of the Temiskaming was held on September 22, when J. P. Bickell, president, informed the shareholders that the entire future of the company depended on the success of the Blue Diamond coal mine in which the company has a half-interest. The old mine could not be operated at a profit unless silver rose above 70c. per ounce and remained there.

The shareholders of the Oxford Cobalt on September 19 ratified the agreement for the purchase of the Waldman claim and two other locations giving the company a total area of 100 acres. The installation of the new plant using electric power has been completed and sinking resumed.

The liquidation in connection with the Bailey Cobalt Mines, which has lasted for seven years, was brought to a close on September 23 when the shareholders authorized the directors to make application to terminate proceedings. In accordance with the settlement effected the Bailey Cobalt is now a holding company with an interest in the Bailey Silver Mines, Ltd., which has taken over the assets of the Bailey Cobalt and the Bailey Silver Customs mill. The company has completed a standard-gauge railway siding from the Nipissing Central Railway to its mine, and can now ship ore direct from its mine to the mill.

Porcupine.—At the annual meeting of the McIntyre-Porcupine on September 22, J. P. Bickell, president, stated that fears were entertained of a power shortage as the streams had been dried up to an unusual degree by the excessive heat of the summer. Arrangements had been made for the installation of an auxiliary steam-plant later in the year should it appear necessary. He explained that the Blue Diamond coal mine of Alberta, of which the McIntyre and Temiskaming companies are joint owners, had been operating at a profit during the last two months. R. J. Ennis, general manager, stated that the present estimated value of ore-reserves down to the 1500-ft. level was $6,292,000.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

W. H. Goodchild is at Kirkland Lake, in Ontario.

E. J. Collins, of Duluth, Minnesota, was here last week.

Henry Hanson is in San Francisco from Keeler, California.

F. J. Nagel, of Denver, is at Guadalajara, Jalisco, Mexico.

Arthur I. Davis, of Toronto, Canada, was in San Francisco last week.

Henry Krumb is at Los Angeles, where he will remain for some time.

Charles F. Williams, of Mansfield, Ohio, is now at Keno Hill, in the Yukon.

R. L. Chase is examining properties near Ouray and Silverton, Colorado.

Lewis Bradbury has returned to Los Angeles. He will be going to Mexico shortly.

E. A. Manderfield, of Houghton, Michigan, is at Santa Eulalia, Chihuahua, Mexico.

Walter Fitch, president of the Chief Con. Mining Co., at Eureka, Utah, is in southern California.

C. T. Hutchinson, business manager for the 'M. & S. P.', leaves for Chicago and New York on October 7.

W. D. McMillan left San Francisco on October 4, to return to the Kasin diamond-fields in the Belgian Congo.

Daniel Guggenheim, formerly president of the American Smelting & Refining Co., has returned to New York from Europe.

Samuel W. Cohen has returned to Montreal after an examination of the Murray claims at Elbow Lake, in northern Manitoba.

C. A. Weck, of Oakland, has completed a preliminary examination of the placer mines of the lower Trinity river, near Salyer, California.

Robert N. Bell, formerly State Metal Mine Inspector of Idaho, and now a consulting mining engineer at Boise, spent several days at Salt Lake City recently.

S. Paul Lindau has become engineer for the Western branch of the United States Gypsum Co., with offices in the Citizen's National Bank Bdg., Los Angeles.

T. A. Rickard has been invited to deliver the principal address on the occasion of the 50th anniversary of the Missouri School of Mines, at Rolla, on November 5.

G. W. Gray has resigned as assistant manager and chief mining engineer to the Rio Tinto mines in Spain, and has entered into partnership with **W. Selkirk**, consulting mining engineer, London.

Harry Sordy, who has been with the Gold Mint Mining Co., at Wasilla, Alaska, sailed on the 'Northwester' from Seward for Seattle. He will be superintendent for the Almeda Mines Co., at Merlin, Oregon.

Henry J. Kimman, since 1902 manager of the Cleveland, Ohio, plant of the Chicago Pneumatic Tool Co., died at Cleveland on September 7. He was born in Holland in 1863, and emigrated to America with his parents who settled at Chicago in 1870. Being of a mechanical turn of mind he designed and in collaboration with his brother, T. P. Kimman, built one of the first practical portable piston air-drills, known as the Little Giant. Soon after engaging in the manufacture of air-drills he became associated with E. N. Hurley and and they formed the Standard Pneumatic Tool Co. in 1898. He became associated with the Chicago Pneumatic Tool Co. in the consolidation made in 1901, at which time he became manager of the Cleveland plant of the company, in which capacity he remained until his death.

THE METAL MARKET

METAL PRICES

San Francisco, September 27

Aluminum-dust, cents per pound	65
Aluminum, sheet, cents per pound	72
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	12.25—12.50
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$96
Zinc, slab, cents per pound	6
Zinc-dust, cents per pound	9

EASTERN METAL MARKET

(By wire from New York)

October 4.—Copper is active and strong. Lead is quiet but firm. Zinc is more active and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 27	71.62	43.37	Aug. 22	61.78	38.29
" 28	71.37	43.12	" 29	62.10	38.10
" 29	71.37	43.25	Sept. 5	62.50	38.10
" 30	70.50	42.62	" 12	63.96	38.98
Oct. 1	70.87	42.87	" 19	65.14	39.56
" 2 Sunday			" 26	67.68	40.96
" 3	70.70	42.12	Oct. 3	71.07	42.89

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59 33	Oct.	119.10	83.48	....
May	107.23	102.69	59 90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Sept. 27	12.12	Aug. 22	11.75
" 28	12.12	" 29	11.58
" 29	12.25	Sept. 5	11.72
" 30	12.25	" 12	11.94
Oct. 1	12.25	" 19	12.08
" 2 Sunday		" 26	12.12
" 3	12.25	Oct. 3	12.21

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 27	4.70	Aug. 22	4.40
" 28	4.70	" 29	4.40
" 29	4.70	Sept. 5	4.44
" 30	4.70	" 12	4.55
Oct. 1	4.70	" 19	4.60
" 2 Sunday		" 26	4.68
" 3	4.70	Oct. 3	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	....
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Sept. 27	4.85	Aug. 22	4.70
" 28	4.87	" 29	4.65
" 29	4.95	Sept. 5	4.67
" 30	5.00	" 12	4.70
Oct. 1	5.00	" 19	4.70
" 2 Sunday		" 26	4.73
" 3	5.00	Oct. 3	4.94

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.37	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Sept. 6	47.50	Sept. 20	47.50
" 13	47.50	" 27	47.50
		Oct. 4	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

MINE STATISTICS

The following recently issued statistics from the Census Bureau cover the year 1919. While they deal with a period two years ago they contain some interesting information. The statement reports as value of products the amounts received by operators for the ores, concentrates, bullion, etc., produced and does not show value of metals recovered from these products. This amount includes receipts for by-products, custom milling, power sold, and miscellaneous services to other enterprises. It includes, also, a duplication approximately equivalent to amount reported as 'cost of ore purchased', which in value of ore sold by some producers to others for further treatment and re-sale, and again reported.

Gold, silver, copper, lead, and zinc mines in United States, exclusive of Alaska, produced approximately 61,839,200 net tons of ore, containing 1,833,300 oz. of gold, 51,224,300 oz. of silver, 582,500 net tons of copper, 443,000 net tons of lead, and 549,200 net tons of 'recoverable' zinc. Placer mines yielded approximately 464,000 oz. of gold, 45,400 oz. of silver, and 800 oz. of crude platinum.

	Total	Copper mines	Lead and zinc mines	Gold and silver mines
Number of enterprises	1,479	195	432	852
Number of mines	1,630	226	473	931
Number of enterprises operating mills in connection with mines	512	57	262	193
Mineral lands operated (acres)	733,503	392,811	135,262	205,430
Persons engaged	90,211	46,999	24,030	19,182
Proprietors and firm members	1,349	103	412	834
Salaried employees	6,445	3,179	1,734	1,532
Wage earners (average)	82,417	43,717	21,884	16,816
Power used (hp.)	938,444	523,591	229,541	185,312
Capital	$1,355,825,983	$853,639,017	$197,223,814	$304,963,151
Principal expenses:				
Salaries	15,317,235	8,039,741	3,834,940	3,442,554
Wages	122,830,242	66,390,194	30,708,319	25,731,729
Supplies and material	64,872,542	34,275,369	15,311,548	15,285,625
Fuel	15,737,317	11,310,485	2,783,249	1,643,583
Power	9,607,446	3,555,530	2,591,906	3,460,010
Royalties and rents	6,898,624	536,819	5,260,187	1,101,618
Taxes	18,237,579	12,229,046	3,326,910	2,681,623
Expended for development (included in above)	25,635,493	13,302,349	4,268,914	3,064,230
Value of products	325,038,325	181,258,087	75,579,347	68,200,891

MONEY AND EXCHANGE

Foreign quotations on October 4 are as follows:

Sterling, dollars:	Cable	3.74
	Demand	3.74½
Franc, cents:	Cable	7.18
	Demand	7.20
Lira, cents:	Demand	4.15
Mark, cents		0.88

Eastern Metal Market

New York, September 28.

A distinctly cheerful tone permeates all the markets. Prices in most of them have advanced and all are firm to steady.

Copper buying has increased; but while prices are thus far firm, they are not higher.

Steady buying of Straits tin continues with prices firm to higher.

Another advance is recorded in lead, with the good demand sustained.

The zinc market is decidedly more active and higher.

Antimony has also advanced.

IRON AND STEEL

Leaders in the steel trade speak of larger mill-operations in the last quarter of the year with a confidence they did not show as September opened. The past week has brought further signs of betterment, says 'The Iron Age'. As in wire products two weeks previous, the advance for sheets brought a flood of orders and specifications at the old prices, estimated at close to 200,000 tons. Sheet manufacturers are running at 70 to 75% of capacity under the replenished demand developed by the new turn in the market. There is pretty general adherence to the new prices on black and galvanized sheets. Along with this advance has come an effort to lift the sheet-bar market. Two or three independent mills ask $32, or $2 above the present contract basis. Not a little stir was created by the action of the Carnegie Steel Co., which became known on Monday, putting its prices on plates and structural shapes at 1.75c. and on bars at 1.65c.

The increased rate of wire, sheet, and tin-plate production is encouraging, but these light products make a smaller increase in the output of ingots than might be gathered from some optimistic reviews of the week.

The pig-iron market shows a decided increase in buying. One manufacturing company has purchased 15,000 tons of foundry iron for last-quarter delivery, 5000 tons for each of its three plants.

COPPER

The better feeling which has permeated nearly all the markets recently has at last had a definite reflection in the copper market. Consumers have been waiting in the belief that the recent stiffness in values was unwarranted and that they could purchase at lower prices later. With the close of the month and no evidence of the weakness which has characterized the market in previous recent months, buyers have become more interested. This has resulted in larger inquiry and in the buying in the past week, by one large consumer, of 5,000,000 lb. of electrolytic copper. There have been other small sales, but this one is easily the feature and dwarfs anything in some time. It is reported that the same company is about to ask for another 2500 tons. There are also unconfirmed reports that at least 4000 tons in all was sold last week for domestic consumption. The large purchase referred to was made at prices ranging from 11.90c. to 12.37½c., delivered, and this has resulted in the cleaning up of all 12.25c. metal, it is believed, thus placing the market firmly on a 12.37½c., delivered, or 12.12½c., New York, basis. Some are quoting as high as 12.50c., delivered. Foreign demand, in view of exchange, is moderate, except perhaps to the Far East.

TIN

The market each day of the week covered by this report has been quiet to stagnant excepting on one day, Wednesday, September 21, when 300 to 400 tons of spot and future Straits tin was sold, nearly all to consumers. The prices varied from 26.62½c. for spot to 26.87½c. for future. This steady buying of Straits tin has been a feature of each week's report for some time now and Straits tin easily dominates the market. Arrivals thus far this month have been 2560 tons with 3025 tons reported afloat.

LEAD

The market continues to rise, due again this week to an advance by the leading producer which last Friday raised its price from 4.65 to 4.70c., New York and St. Louis. Demand has been and is so good that it is stated that this producer is out of the market. With most independent sellers unwilling to sell as low as 4.70c., New York, the outside market is generally quoted at 4.75 to 4.80c., New York, or 4.45 to 4.50c., St. Louis. The market is strong and cheerful.

ZINC

A decided change has come over this market. Buying has increased and inquiries are more numerous. Prices have also advanced until prime Western for early delivery is difficult to buy as low as 4.35c., St. Louis, or 4.85c., New York. One reason is that producers are selling only their monthly production and not their stocks and at the end of the month have sold practically all metal available. Also output is estimated to be under 20% of capacity as it exists today. Prime Western for early or October delivery is quoted at 4.35 to 4.40c., St. Louis, or 4.85 to 4.90c., New York. There has also been a good demand for high-grade metal from galvanizers of wire, sales having been made at a fairly large spread over prime Western values, based on St. Louis prices.

ANTIMONY

The market is higher, due largely to advance in asking prices of holders of spot antimony. Wholesale lots for early delivery are quoted at 4.60c., New York, duty paid.

ALUMINUM

The leading interest has not changed its quotation for wholesale lots of virgin metal, 98 to 99% pure, which still stands at 24.50c., f.o.b. plant, but imported metal is a little lower at 18 to 20c., New York, duty paid.

ORES

Tungsten: The improvement in the steel trade has not yet been reflected in this market and prices continue nominally unchanged at $3 per unit up, depending on the grade and the quantity.

Ferro-tungsten: There has been no change, the quotation for the domestic alloy being nominal at around 40 to 45c., while the foreign product is quoted at 50c. per pound of contained tungsten.

Molybdenum: There is no demand and prices are nominal at 50c. per pound of MoS_2 in regular concentrates.

Manganese: High-grade foreign ore is quoted at 20c. per unit, seaboard, with no demand reported. Imports in August are officially reported as 28,939 gross tons, making the total for the first eight months 326,342 tons, against 334,590 tons for the same eight months last year.

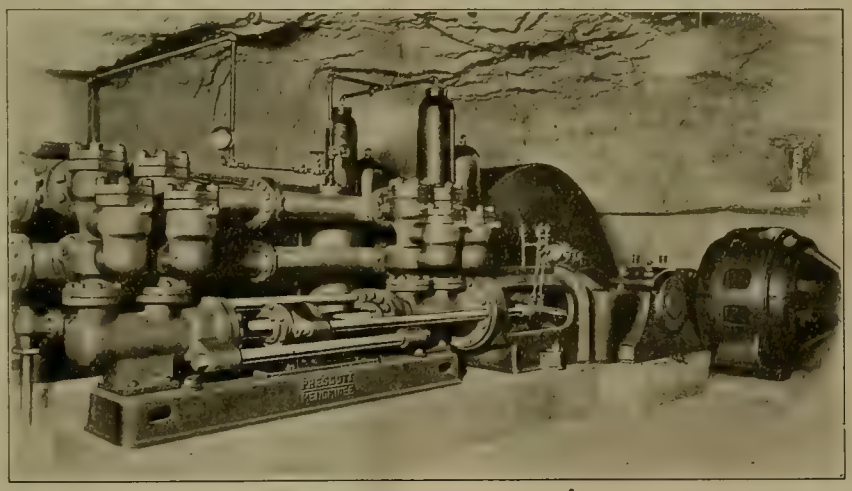
Manganese-Iron Alloys: Demand for ferro-manganese has quieted down and sales of only 300 tons are reported in the past week. Inquiries are confined to a few carload lots. Prices are unchanged at $58.35, seaboard, for the British alloy, with American producers meeting this price, adding the freight to point of consumption. Imports of ferro-manganese in August were only 320 tons, or 5801 tons for the first 8 months as against 33,515 tons for the first 8 months in 1920. There is only a light demand for spiegeleisen with prices unchanged at $25 to $26, furnace.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

ELECTRIC PUMPS UNDERGROUND

'Prescott-Menominee Mine-Pumps' is the title of an exceptionally handsome new catalogue just published by the Prescott Co., of Menominee, Michigan. The company specializes in electric pumps for deep mines, and the greater part of the new publication is devoted to a description of equipment designed for this purpose. Recent years have witnessed a remarkable develepment in pumping machinery for mines. There are two important reasons for this: the ever-increasing use and adaptation of electricity in mining operations, and the increasing depths to which mine-shafts are sunk. Electrically-driven hoists, compressors, and haulage-systems are being used more widely than ever and the same tendency is evident in the building of pumping machinery. Generally electric pumps can be operated more economically than steam; but, even if they could not, there is a convenience about them that is highly desirable. There are no long leaky steam-lines in the shafts with their attendant losses. Electric pumps are clean and easy to handle; the pump-rooms can be kept cool and comfortable instead of over-heated. The cost of pumping is receiving particular attention at this time and economy of operation is really more important than low first cost.



Prescott-Menominee Electric Pump Lifting 2400 Feet

Prescott-Menominee pumps are designed and built by men who are familiar with underground conditions and who understand the requirements of severe and continuous service. None but the best can stand up under such conditions and it is to meet these conditions that Prescott-Menominee pumps are designed and built.

There are three governing factors in the type of water-end to be selected for mine pumping: the quantity of water to be handled, the character of the water, and the head, or pressure, against which it is to be pumped. Above all things, water-ends must be strong enough to stand their working pressure with a large factor of safety, their metal must be of ample thickness and properly apportioned to the various sections and parts. Mine-pump water-ends are continually being subjected to shock-pressures which sometimes even exceed the load. This danger becomes emphasized in electric pumps because of their positive and rigid power-action as compared with steam-driven pumps with their resiliancy and steam-cushion effect which tends to absorb or soften similar shock.

Of equal importance is their design with reference to the flow of water through them. Water-passages and valve-areas must be not only large enough to keep friction-losses down to a minimum, but so designed to keep the velocity uniform throughout the pump. This feature of low and uniform velocities is of vital importance, for it permits of the highest plunger-speeds without loss of power due to excessive friction and on it largely depends the economic performance of the entire unit.

Power-transmission to the water-ends in most of the Prescott-Menominee pumps is accomplished through a set of single-reduction double-helical gears of the herringbone type. The fundamental and conspicuous advantages of this kind of gearing are its greatly increased mechanical efficiency over all other forms and the high ratios of reduction possible between the gear and pinion. The entire power-end of Prescott pumps is heavy, strong, and absolutely solid and rigid; a condition which is of vital importance on motor-driven geared pumping-units. The reason for using herringbone gears on electric- and power-driven pumps is often asked, and why these gears are considered superior to the older forms of straight-tooth or spur gears. The reasons follow: The work of the pinion-gear is to so drive the other gear that it will revolve steadily and continuously; consequently there should be no intermittency in the tooth pressure at any time or in any part of the revolution. Spur-gears

do not fully answer this requirement, while herringbone gears do. The method by which a small spur-pinion drives a larger gear has been described as striking its teeth a succession of blows with a hammer. This may sound like an exaggerated statement, yet it describes precisely the action of a straight-toothed pinion, especially if it has but few teeth or becomes worn.

Herringbone gears are really double helical gears, with the helix (spiral angle) of teeth sufficiently steep to ensure an overlapping or screw-like contact between the adjacent teeth, thus compelling a uniform, even, and continuous shove or push in the direction of the load and throughout the entire revolution. It is clear, therefore, that this form of gear much more nearly approaches the ideal in the performance of the work desired.

The concluding pages of the booklet are devoted to some useful engineering tables and sundry general information for the pump user.

THE KROM SINTERING SYSTEM

The Krom sintering system successfully overcomes, it is said, the difficulty pertaining to the sintering of those ores, flue-dust, concentrates, etc., which are in a finely divided form, and which stick tenaciously to the sintering grate. The former condition requires special mechanical construction for securing a uniform sintering draught through the charge, and the latter condition requires means for economically removing the same from the grate. The Krom system of sintering is based on the unit-oven principle, so successfully developed by the modern by-product coke-ovens.

To produce either coke or sinter most satisfactorily the period of heat treatment must be under control independent of all other steps in the process, such as charging, igniting, and discharging. In both coking and sintering operations the treatment is perfectly controlled by unit charges, namely, separate ovens or pans independently charged and discharged.

The Krom equipment consists of a battery of circular cast-iron pans. The circular form of the pan has the following advantages:

First—The suction-draught. The bottom or grate portion of the pan is adapted to a cone-shaped sheet-iron extension, from the apex of which the suction-draught is drawn. This construction ensures an even draught of air through all portions of the sinter charge resting on the pan-grate above; on account of this construction the pans can be made of a size to suit as small or as large a capacity as the operation may require.

Second—Charging the pan. The circular form of the pan allows the charge to be quickly and evenly distributed without compression or packing, and is accomplished by a rotary distributer.

A motor-driven traveling igniter equipped with burners for gas or oil, which cover the entire surface of the pan, is used.

Discharging is accomplished by a new method, namely, the retaining walls of the pan holding the charge on the grate also form a motor-driven ram for pushing off the finished sinter. The rim or the retaining wall of the pan is mounted on wheels and is provided with a cast-steel plow. This plow travels clear of the grate section, ripping the sinter cleanly from the grate and at the same time breaking it into desirable sizes. The discharging operation is entirely automatic, fast, and positive in its results.

COMMERCIAL PARAGRAPHS

Bulletin 246 of the **Dayton-Dowd Co.** describes sundry types of centrifugal fire-pumps manufactured at the company's plant at Quincy, Illinois. These pumps have been tested and approved by the National Board of Fire Underwriters.

The Universal Portland Cement Co. announces a reduction in its selling prices for Universal portland cement, effective on September 15, of 20c. per barrel at its Chicago plant, and 15c. per barrel at its Pittsburgh and Duluth plants. This is the second price reduction made by this company this year.

'The Variety of Design in Furnaces' is the title of Pamphlet No. 232, recently issued by the **W. S. Rockwell Co.**, manufacturers of industrial furnaces. The company makes furnaces of several hundred different types and designs and is prepared to supply the most suitable installation for any required purpose. The question of ultimate efficiency of operation is discussed in this booklet. It is pointed out that the advantages of adapting industrial heating equipment to the manufacturing requirements and plant conditions in each individual case are not always appreciated. Consideration only of strictly thermal features of the operation is often responsible for failure to effect the economies which, almost without exception, may be brought about by intelligent selection, arrangement, and operation of equipment properly adapted to the individual plant conditions.

'Storage-Battery Mine-Locomotives' is the subject of leaflet 1888-A, which has just been printed by the **Westinghouse Electric & Manufacturing Co.** This leaflet describes the applications of storage-battery mine-locomotives and illustrates and treats on the Baldwin-Westinghouse type of apparatus. The storage-battery locomotive is particularly adaptable to 'gathering' service and underground haulage, where there are difficulties in erecting and maintaining trolley-wires and in bonding the rails, or where wooden rails are used. It is also suitable for general work on the surface, by the addition of a cab or canopy. Operating under any of the above conditions, it is entirely reliable and very easily operated. The salient advantages of the Baldwin-Westinghouse storage-battery locomotive include accessibility, simplicity, efficiency of operation, and general ruggedness of design. The mining type conforms to the principles established by years of experience in the successful application of mining locomotives of the trolley-type and the construction follows that type as closely as possible.

Mine operators will be interested in learning that the **Treadwell Engineering Co.**, of Easton, Pennsylvania, has placed on the market a new line of hoists, both steam and electric driven. The company, while a long-established and well-known manufacturer of rolling-mill equipment, has not hitherto been so closely identified with the mining field. The company feels that it has been fortunate in securing the services of Thomas O. Werner as chief engineer of its hoist department. Mr. Werner is widely known as a hoist expert, having been associated with the S. Flory Manufacturing Co. in a similar capacity for many years. Among the features which distinguish these new hoists is a double-toggle clutch mechanism which is claimed to be a step forward in design. The clutch is usually mechanically operated by a double-acting cylinder, although it can be arranged for hand operation if desired. A point is made of the fact that the clutch (of the hand-type) drives directly from the rim of the main gear, which carries the driving portion of the clutch, to the friction-flange of the drum. The construction necessarily eliminates any torsional stress in the drum-shaft, and end-strain or thrust in the bearings or operating mechanism, for when brought into play this device is automatically locked. The company is building a complete line and is prepared to offer a machine to meet practically any operating conditions within a range of from 100 to 300 hp. These hoists can be arranged for either electric-motor or steam-engine drive.

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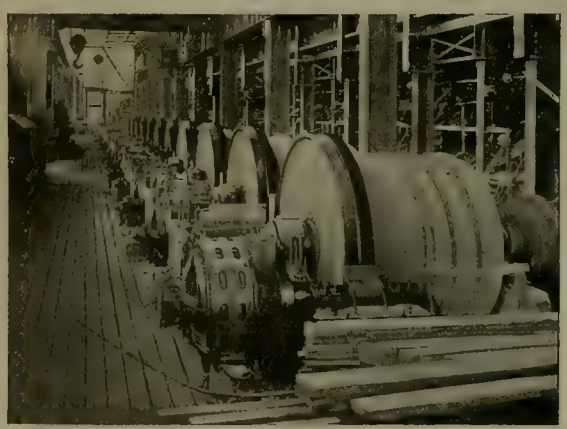


BRADEN—
Marcy Ball-Mill Installation

COPPER QUEEN—
Marcy Roller-Mill Installation

T. A. RICKARD, - - - - Editor

BRITISH participation in American mining has been diminished by the transfer of the Arizona Copper Company's property to the Phelps Dodge Corporation. The terms have been published in our news columns; they are said, by the 'Financial Times' of London, to be disappointing to the British shareholders of the old company, because the shareholders receive only the equivalent of £1,800,000 in exchange for property that not long ago was valued on the Stock Exchange at £3,000,000. Unfortunately for the former shareholders the deal was made at a time when copper mines were at a discount. We congratulate the Phelps Dodge directors on their courage and enterprise.

EXTENDED use of copper and other metals will result from the electrification of railroads, which is as inevitable as was the substitution of the incandescent lamp for the candle. Chile is taking advantage of the low price of metals, the government of that country having recently signed a contract with the Westinghouse Electric & Manufacturing Company for the equipment needed to electrify the State railroad between Valparaiso and Santiago. The cost of the material is $7,000,000, and the contract is said to be the largest of its kind that has been signed since the War. With a little more initiative of a similar nature in other countries, the present period of stagnation in the metal market would soon be passed.

BLESSINGS are often disguised, it is said. We have not the temerity to suggest that the 12½-cent copper market is a blessing, even in disguise, to the producer of the metal; but some consolation can be gained by looking at it from a certain angle. If copper is cheap, things made of copper should be cheap. People know that articles made of copper and brass are superior for many purposes, and, if the price is low, they will be inclined to purchase manufactures of these materials. They will then appreciate more than ever the economy of using high-grade articles and will continue to buy when the price is increased somewhat in conformity with a reasonable advance in the quotation on raw copper. They will form a copper-using habit, and such a habit is as potent an ally as any commodity can have. It may be argued that the longer copper stays at 12 cents, the stronger the habit will become; the trouble is that then the cure would be worse than the disease.

OUR figures (in the issue of September 24) for the total stock of copper on hand were, we find, incorrect; for the reason that no account was taken of the unrefined metal in smelter yards. The U. S. Geological Survey gave the stocks on January 1, this year, as 659 million pounds and the unrefined copper at the smelters as 465 millions, making a total of 1,124,000,000 pounds. On September 1 the total is estimated to have been reduced to 810 millions. Sales for September are estimated at 100 million pounds, whereas production was about 40 millions. At the current rate of relative production and consumption, the surplus at the end of the year should be about 650,000,000 pounds, or only 250,000,000 pounds in excess of the normal quantity in course of refinement.

AN editorial in a recent issue of the 'Journal' of the Society of Chemical Industry affirms that the scope of that institution is "not merely imperial in character"; with its large and enterprising membership throughout the North American continent it gives a practical demonstration of the preliminary success attending community in language, in political ideals, and in scientific development; such an alliance between the United States and Great Britain presents the best hope for permanent peace. Sir William Pope, the retiring president, recently in New York, has rendered a valuable public service in his frank criticism of those who are disinclined to review the physical and chemical basis of existence, or to provide the scientific requirements for its continuance. In spite of the daring and ingenious forecasts made in regard to the latent possibilities of intra-molecular energy, no attempt has been made to harness it. Pending such a consummation, solar energy remains the only source at our disposal; and if the multiplication of government departments were an outward and visible sign of an inward and scientific grace, a nation that first established a Ministry of Radiation might reasonably claim to be the best fitted for racial survival. The experience of a century, however, has taught scientific men that no reliance can be placed on such lumbering and creaky machines for accelerating progress. Our hope,

says the 'Journal', lies in that characteristic of the English-speaking peoples that, emerging from the crucible of a thousand years, has enabled them, during that period, to spread their ideals throughout the world. Adaptability to circumstances, the capacity to face an issue, the patient determination to solve a problem, combine to form an attitude of mind that inspires us to envisage the future without dismay. Scientific enthusiasts will continue to plod their laborious way through the labyrinths of nature's mysteries. Many will spend their lives, as heretofore, revealing secrets that add but little to the sum of knowledge. Occasionally some great truth will be brought to light, and its appearance will wring appreciation from an otherwise unheeding world. Gradually, but inevitably, the system of education will be modified to embrace the fundamentals and to shed the frills; and civilized man will awake to a vision that discerns in clear perspective the real problem he has to solve, and will adopt the only principles by which he can solve it. The chemists are to be congratulated on the firm establishment of a technical society that embraces membership throughout the English-speaking world. This will aid in the attainment of that goal—peaceful progress—for which we all strive, whether we were born on this or that side of an international boundary.

CAPITULATION on the part of the Southern Pacific Company has ended a short but bitter controversy between the railroad corporation and the mining towns of southern and western Nevada. A petition of the company that sought authority to curtail the daily passenger service between Reno and Mina to a schedule of three trains weekly was withdrawn voluntarily on the eve of the hearing before the Nevada Public Service Commission. For twenty years the Southern Pacific Company has maintained daily Pullman service to Mina and thence to Tonopah and Goldfield over the T. & G. tracks, but on September 2, last, notice was served that it desired to curtail this service; the Commission designated September 20 as the date for a public hearing on the petition. The ground for the request was decreased patronage, which made the operation of seven trains per week unprofitable. The Tonopah & Goldfield Company's trains, obviously, would have had to be discontinued to conform with the Southern Pacific schedule. The announcement evoked a storm of protest from a dozen mining towns, led by Tonopah, Mina, Goldfield, and Yerrington, whose business is conducted largely with firms at Reno and San Francisco, and whom therefore any irregularity in the mail and passenger service would inconvenience seriously. Dispatches from Tonopah say that "pressure was brought to bear", from which we infer that a transfer of commercial relations from San Francisco firms to those of Los Angeles was suggested, for the Santa Fe railroad runs trains from Los Angeles to Tonopah by way of Ludlow, where junction is made with the Tonopah & Tidewater line. Besides suffering direct loss of revenue from the possible diversion of freight, the Southern Pacific Company apparently was confronted with the necessity of propitiating the shippers at Reno and San Francisco whose business might suffer. Whatever the reasons may have been, the company decided to withdraw its petition and to "carry the loss sustained by operating these trains for a reasonable length of time, although the officials were not at all fearful of the outcome of the impending hearing". We do not know how great this alleged loss may be, but we believe that the districts served by the railroad have every reason for anticipating increased prosperity, and that the friendship of the residents will be an asset to the company. In Nye county alone the 'camps' of Silverton, Arrowhead, Clifford, Silver Bow, Bellehelen, Argentite, Manhattan, Weepah, Klondyke, Lone Mountain, Golden, and Divide are the scenes of active development. Within a radius of 50 miles of Goldfield, in Esmeralda county, four promising districts are being developed; and mining activity is greater in Mineral county than it has been for many years. The completion of the 150-ton mill of the Simon Silver-Lead company had stimulated the development of a dozen properties. In our opinion the Southern Pacific Company will find that the goodwill of the folks in southern Nevada will be worth more in dollars and cents than the cost of running the extra trains.

Lawlessness

When citizens take it upon themselves to be more legalistic than the officers of the law and more loyal than their representatives in the Government, it bodes ill to a democracy. Several examples of such perversity have been presented to the public lately. The Ku Klux Klan, under cover of a fraternity, with the rites of a secret society, the antics of a tribe of South Sea islanders, and the technique of a Red Cross drive, has gathered to itself a large number of misguided persons who have set themselves to discipline sundry communities by passing sentence upon individuals, subjecting them to tar and feathers, and inflicting other barbarous methods of punishment. Under cover of insignia, declarations, and regalia they condemn citizens by secret edict and without trial; and, forsooth, claim to be 100% American! By a reign of terror they undertake to administer the law; by flouting the law and committing crime they dare to pose as defenders of our democratic institutions. Next we have the affair in West Virginia, where the managers of coal mines operating on the open-shop system armed their men for the purpose of repelling the advances of unionism in the form of representatives of the United Mine Workers. The service of armed men was obtained by the operators under guise of hiring detectives, who were 'gun-men', of the same type as the 'strike-breakers' engaged by mining companies when a labor-union becomes obstreperous. To put it briefly, armed men were hired by the operators in order to close the 'open shop' and to exclude the emissaries of unionization, who thereupon armed themselves and started a civil war, to end which it became necessary for the President to send Federal troops to the coalfield. Both sides tried to secure their own ends by force, in complete disregard of the law.

More recently in our own State, in the Kern River oil-field, the union men, in order to exclude non-union men, armed themselves and terrorized the community. They 'held up' travelers on the high-road and talked in terms of organized warfare. These antics were facilitated by means of a legal subterfuge, whereby the sheriff appointed the men as deputies and thereby gave them the right to arm themselves and to interfere with the movements of their fellow-citizens. The 'deputies' in California were analogous to the 'detectives' in West Virginia; in both cases they were law-breakers masquerading as the upholders of the law. These affairs, as also the Bisbee deportations of July 1917, are manifestations of a spirit subversive of our democratic institutions, whether those responsible for them be officials or private citizens, educated men or hoboes, union men or non-union men, natives or aliens; each of these episodes is a slap at the fair face of democracy and an insult to the national flag.

To correct this orgy of lawlessness there is needed a healthy public opinion, and to develop that we need an honest and fearless press. Unfortunately most of our newspapers are committed to one or the other side in the industrial conflict, and most of them represent the employer class, so that impartial criticism is rare; nevertheless it is certain that in the end the weight of public opinion is decisive, and therefore any wrong-doing or unfairness on either side would win public reprobation if only the facts were made known. There's the rub; some journals are so prejudiced, so committed to a partisan view, that they do not even give their readers the facts upon which a just opinion may be based. For example, the 'Mining Congress Journal', which ought to be spokesman for the enlightened opinion of those engaged in mining, is unable to discuss any labor problem except from the point of view of a Vanderbilt, a Baer, or a Gary. In its current issue it travesties the facts of the West Virginia affair and then proceeds to describe the efforts of the United Mine Workers to unionize the coal miners in the following terms: "They were outsiders, aliens who sought to drive out the inhabitants and possess themselves of the land, and they had exactly the same justification for their conduct that the Moorish hordes had for invading Spain, that the Tartars had for overrunning northern Europe, and that the Germans had for blasting their way through Belgium". This sublimated piffle might have been written by a very young man under the combined effects of three mince pies and two pints of hooch. The Mining Congress is woefully mistaken in supposing that such stuff, and such a mental attitude, will serve to disentangle our economic troubles or lessen the friction arising between employers and employees in the industry of mining. Its attitude on the labor question has been narrow and perverse; it provokes lawlessness instead of allaying it; it obscures the real issue with sophomoric digressions that are as ridiculous as they are inappropriate. It fails to represent the men of the mining industry, to whom such antics are repellant. The violent language it uses—the language of a reckless and ignorant schoolboy—will settle no labor trouble, for it bears no trace of sober thought; nor will it stop lawlessness, for it breeds more mischief. The questions involved in these matters are complicated enough already without the injection of an ignorant venom; if they are to be settled, for the good of the community as a whole, they must engage the best thought of the most thoughtful men, not the silly vaporings of an irresponsible scribbler.

Hunting for Ore

In the current issue of 'Economic Geology' Mr. Augustus Locke contributes a striking and thoughtful article on the profession of ore-hunting, as he terms it; and many of his arguments should provoke discussion. He introduces the subject by stressing the point that commercial mining geology has failed to reach the research stage; no adequate financial support for broadly planned experimental operation has been forthcoming, because the application of geological knowledge and experience is not generally accepted as the best method for the discovery of ore. Chief among the reasons for this is the fact that it is inconspicuous. The adoption of rule-of-thumb methods and the development of surficial ore deposits have resulted in the establishment, in this country, of the greatest mining industry in the world, but the time has come when fresh discoveries are increasingly difficult to make. It is probable that few great deposits remain that may be found by ordinary prospecting or because they are plainly indicated by outcrops. The application of a new commercial geology is imperative; this must rely for its success primarily on research. The work will be done through three main groups of specialists—chemists, structural geologists, and mineralogists, respectively. The success of the scheme will depend to a large extent on the geologists themselves, for it is essential that they stimulate the spirit of research within the profession. They can preach its necessity; they can refuse engagements proposed under a meagre scale of pay; they can insist, when conditions are promising, on enough capital for an adequate investigation; they can undertake research on their own initiative in subjects of commercial interest. Thus will they be able to destroy the charlatan, betray the parrot that talks like a man, and distinguish the result of the lucky guess from the well-planned technical achievement. The outstanding impediment in mining geology, we are told by Mr. Locke, is the lack of a special technology devoted to the subject of hunting for ore; geology, as a guide to ore, is without a literature; it needs the inventive spirit. This question leads to a consideration of what is known as the scientific ore-hunter, who is inclined too often to disguise vagueness by means of scientific jargon; others of the same type speak and live by the book alone. These men, as Mr. Locke remarks, give to science a look of futility, the cause being, not science, but a lack of science; for the opinions of the real scientist will carry conviction to the coldest business man. However, even toward the best type, the operator's antagonism remains; the result will be the hindering of appropriations to the real geologist.

The money needed, Mr. Locke argues, must come from the mining companies; it is the geologist's task to prove that science is needed in the work of hunting for ore. In an attempt to determine the cause of vagueness in commercial mining geology it is pertinent to note the author's opinion that an adherence to *a priori* methods is largely responsible; a greater degree of empirical reasoning is needed, based on actual evidence, actual examples, and actual enrichments. Moreover, the geologist should have a mind that is sufficiently fruitful to supply the necessary hypotheses, and an activity that is relentless in testing their accuracy. Above all, there is need for men who possess both the positive and the imaginative knowledge of conditions in a large number of mining districts; such a man needs a shrewd schooling in half the mines of the country. The second most important reason for habitual vagueness is the frequent failure on the part of the geologist to confine himself to the actual purpose of the work, which is to supply information cheaply. For instance, in many cases a report that wanders off into a discussion of considerations other than of grade is essentially defective; it is answering questions that never have been asked. In every report there is scarcely a turn when the dominant theme cannot be developed; every sentence should be purposeful. The history of a prospect, for instance, should contain an explanation of events, not merely a chronicle of them. The introduction of controversial matters should be avoided. With notable exceptions, among which may be mentioned the work of the Anaconda Copper company, geological maps are loaded with answers to questions that never have been asked. Thus it is that lack of financial support is due to a neglect on the part of the geologist to understand the requirements of the operator. A geologic report should carry the mind of the reader to an effective conclusion; it should focus the attention, of the writer as well as the reader, on those considerations, chiefly empirical, that are connected with the discovery of ore.

A third reason for the vagueness in geological reports is due to the practice, especially common among those of immature judgment, of stating conclusions without mention of the degree of doubt without which they cannot be accepted. Failure to express the degree suggests a failure to estimate it; speculation, qualified by a clear indication of the degree of doubt, should be the soul of the report. The more active-minded the writer, the more thought he exhibits, the greater the conviction he carries. Geology may be defined as a speculation with its more fantastic parts removed; its fundamentals should be advanced in such a manner that attention is focused chiefly on probabilities defined by empirical evidence. Another source of vagueness is found in the degree of incompleteness that characterizes many reports. Absolute completeness is, of course, unattainable; but a geological report should include all pertinent considerations; it may be accepted as complete when, after repeated study, no new vital matter is added; stability of opinion is reached. The result cannot be accomplished in a hurry; it takes time and thought. The final cause is described as arising from isolation of opinion. Secrecy occasionally means dishonesty; often it denotes ignorance. Mr. Locke advises the young geologist to spend at least half his time in preparing his arguments in a clear and complete condition. If this advice were to be taken seriously, much half-baked material would never be submitted or published; moreover, opinions and deductions of value would be forthcoming in greater quantity. Mr. Locke's comments on this phase of the matter are true and forceful. A staff geologist, he says, who has no desire to publish is unlikely to do important geological work; a mining company would do well to rebuff the secret worker; it should raise an employee's pay when he can write a good article that attracts attention and invites the opinions of others. Such co-operation, however, must rest on positive ability; it involves the cultivation of a sense of genuine intellectual fairness—a fairness that should be made positive, even aggressive; in this sense it is an important factor in ore-hunting. Geology is no place for harsh difference of opinion; the worst aspect of apex litigation lies, says Mr. Locke, in its encouragement and conspicuous exemplification of antagonisms of such a character, which, incompatible as they are with the progress of the profession, become highly profitable to sundry technicians, in fame as well as in money. Apex litigation is the enemy of co-operation; in that sense it is the enemy of geology. The controversial spirit poisons thinking; trammeled with prejudice, error may result. In short, the geologist must subordinate temperament to logic; it is as well to avoid the man who is always seeking preferment for his own mental offspring. The record, insists Mr. Locke, is an integral part of geological work; it must possess, in order to carry conviction, a greater proportion of intrinsic logic than the spoken word, for the personality and the magnetism of the speaker are not available. The writer must establish the conviction that he is sincere, fair-minded, and competent. He will avoid the careless use of superlatives. One of the indications of shrewdness is a sense of humor; the writer should never be so dull as to remain unsuspecting while the reader laughs. On the other hand, he should never commit the sin of boring his audience. In conclusion, Mr. Locke draws attention to the difficulty in finding competent men. A disadvantage arises from the fact that geologists who have achieved success are removed by what he terms 'decantation'. No able man will be long content with the routine, the cramped authority, and the small pay that characterize the usual staff job. When the average geologist reaches the consulting class it is an index that he is competent. He often possesses business ability in addition to technical ability, and is tempted to utilize it in other directions. He becomes a manager or an owner of a mine, or an editor; his career as an ore-hunter stops abruptly. Thus there is danger that the profession will retain only those that are incompetent in business matters. So long as ability is wary at the entrance and adroit at the exit, the personnel of the profession of economic geology will remain of poor average quality.

Valuation of Placer Deposits

The Editor:

Sir—Mr. Gerald H. Hutton's article in your issue of September 10 constitutes a valuable contribution to the literature of gold-dredging.

The methods that Mr. Hutton describes for correcting possible errors in drilling of placer deposits are interesting and important, but I believe it is seldom that so many safeguards are employed. The average driller measures the core before and after he has driven his pipe and after he has drilled the core, contenting himself with noting in his log the height of the core, and paying no attention to the amount of slime produced by the drilling of the core.

In explanation of, and apology for, this seeming carelessness in the handling of the core material, it must be borne in mind that the drill-pipe cannot cut a true cylinder from irregular ground that consists of sand, gravel, stone, and occassional boulders. Hence the sample taken cannot accurately represent the opening made by the pipe, as it is certain that many stones encountered by the shoe must be driven into the bank or into the pipe, whereas the stone should have been cut in two. The impossibility of making a true section of the ground is an excuse for the apparent carelessness in handling the sludge derived from the hole.

Mr. Hutton's suggested method for arriving at the average value of a number of drill-holes is a valuable one. The cancellation of a low hole as against a high hole appears to me to be warranted by the experience obtained in the field. In the case which he mentioned, and of which he gives a graphic illustration, he has canceled two high holes against two low holes, using the metal-values of the holes instead of the multiple obtained from depth multiplied by value.

It would be interesting to know how this graph would look if Mr. Hutton used this multiple ($D \times V$) instead of the value alone. It often appears that the highest value is obtained in a shallow hole on account of the lack of barren overburden or on account of an accumulation of gold upon a high reef of bedrock, and therefore, this multiple ($D \times V$) would not make as high a peak in the graph representation of the drill average as would be shown by the plotting of values alone.

The example given by Mr. Hutton shows an actual average on the 23 drill-holes, accepting them to be of the same depth, of 14.09c. After eliminating the two high holes and the two low holes, the average is 8.46c. I believe that had Mr. Hutton used the $D \times V$ figures in his graph and in his elimination, he would have obtained a somewhat different average value for the 23 holes and it would be interesting to know what that figure thus obtained would be. In my own practice, I usually made the first estimate of the average value by the usual method, figuring $D \times V$ on all holes and dividing the total of $D \times V$ by the total of depth. In this calculation, I included all holes, high and low. If there were any freak holes, I then proceeded to deduct from the total $D \times V$ the value of these high holes, and in place of these high $D \times V$ values, substitute the average value obtained from all holes. Add these $D \times V$ figures again and divide by the total depth to obtain a new average. If I used this same method upon the 23 drill-holes presented by Mr. Hutton, I find the following figures:

The total of all his values is 324. Deduct from this the two high holes, $114 + 45$, or 159, it leaves us 165. Add to this twice 14.1 (the average of all holes) and we have a figure of 193.2. Divide this by 23, and we get an average of 8.40c., as against Mr. Hutton's average of 8.46c., which is a close check.

In studying Mr. Hutton's algebraic calculation to arrive at the number of yards represented by a high hole, he assumes that holes 'A' and 'B' represent 20,000 cubic yards each, and I would prefer therefore, to start with the equation, 'A' plus 'B' equal 40,000 cu. yd., not 20,000 cu. yd. This substitution carried throughout the calculation gives us a final value of 'B' equals 37,692.8 yd. and 'A' equals 2307.2 yd. These figures give the algebraic quantity of material contained in 40,000 yd. represented by the two drill-holes of high and low metallic contact. While these figures are correct algebraically, I cannot bring myself to believe that a hole showing $1.14 per cubic yard in an area representing 20,000 cu. yd. will ever deliver 1153 yd. of average value indicated by the hole.

After dredging through a number of such enticing patches and holes, with much disappointment as to the results, I have come to believe that a high freak hole represents a very small area and should be either eliminated entirely, or discounted, as I have suggested heretofore.

JAS. W. NEILL.

San Francisco, September 14.

Revision of the Mining Law

The Editor:

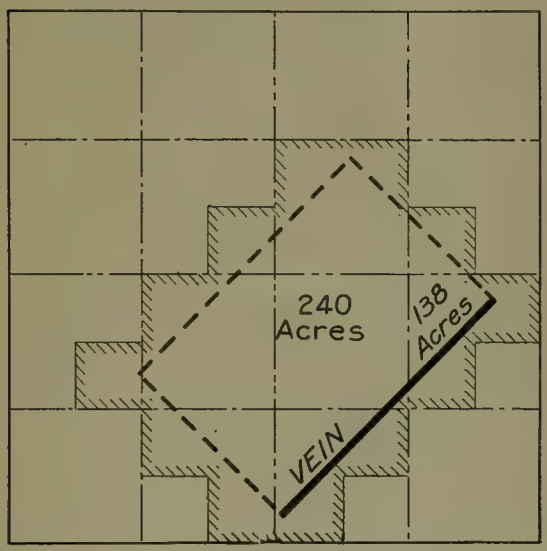
Sir—In discussing the proposed new mining law there are several points that your correspondents do not seem to have covered.

At the present time, I think it is safe to say that the average location survey, 600 by 1500 ft., can be surveyed and staked in half a day. Actually to tape a location through timber would take longer perhaps; for stadia

measurements on the desert, less time would be required.

If under the new law the claim must be surveyed by legal subdivision, let us take as an example a section where all the corners are easily found, as is rarely the case, but no quarter-corners can be found. To survey this section properly and cut out a given area would require 6 miles of surveying at least, and probably take on an average 3 days with stadia and 6 days with a tape. The work of surveying will be greatly increased if the corners cannot easily be found and this is usually the case. This means that the claimant's surveying would cost from 6 to 12 times as much as it does at present. I have in mind an area of country in Garfield county, Colorado, where there are no section-corners within 6 miles and where the survey of about 20 oil-shale placer claims has already cost something like $1500.

If in the example used above the quarter-corners can-



not be found and are replaced according to the rules of the General Land Office, it is possible that years afterward some one will dig up a lost quarter-corner and make all the previous work of no value. It is always necessary to keep this possibility in mind.

Take the case of a flat vein dipping 45° and striking north-east as shown in the accompanying sketch. Suppose the claimant wishes to take up this vein for 3000 ft. in length, and provide for working it to a vertical depth of 2000 ft. It will be necessary to locate 240 acres as shown, when all the ground really needed is about 138 acres. The surveying would be difficult, as practically the whole section would have to be surveyed. The necessary dip calculations would be beyond the uneducated man. If the ground is patented, the owner will have to pay taxes on 240 acres in place of the 138 acres that he really wants.

In most counties in Colorado the greater number of patented claims are actually paying taxes on about 10 acres for each lode claim; in four counties, on 5 acres only. Under the proposed new law, in order to get the rights to one of these lodes on the dip it may be necessary to take up 100 acres and pay taxes on from 5 to 20 times as much ground.

This wholesale taking up of land will probably cause the Forest Service to sit up and take notice, for whereas the locating of 20 acres as at present is a relatively small matter, the Service would probably 'view with alarm' the taking up of areas in lots of 160 acres, and prevent the location and patenting of many promising lodes.

If it is desirable to do away with the extra-lateral right and have a square location, then some of the difficulties of the proposed law might be obviated by providing that such square locations need not necessarily be laid out along cardinal lines, or according to legal subdivision of the public land survey. A survey of this kind could be made by any one with a slight knowledge of surveying, and, aside from taking a little more time, could be made as easily as the location of claims at present. Such claims could also be laid out easier where it was desired to cover fractions of ground. Under the proposed law, to cover a certain unlocated fraction it might be necessary to lay out four 10-acre lots, where perhaps only one acre was desired.

The provision requiring that claims shall be filled with the Land Office may be wise, but it leads to double expense. All locations that change hands will also be filed necessarily with the County Recorder, or some such officer, just as patents are now, or it will be impossible to preserve the chain of title or get an abstract for any piece of land.

In short, every step that the locator takes under the proposed law will cost him from two to ten times what it costs at the present time, and the only gain as far as I am able to see will be the doing away of the extra-lateral right. The extra-lateral right has been one of the greatest incentives to prospecting in the past, and with that gone and the other features of the new law in operation, we can foresee an end to prospecting, or at least such prospecting as we have had up to the present time.

JAMES UNDERHILL.

Golden, Colorado, September 20.

The Editor:

Sir—It seems to me that Mr. Spear, in a recent letter to you on the subject of the proposed new mining law, makes a strong criticism when he points out the difficulty of finding Government corners. The fact of the matter is that the Government land surveys exist for the most part on paper only. This means that a prospector, in order to make a location under the proposed law, must hire a surveyor. If the time necessary for a Deputy Mineral Surveyor to locate a Government corner in the average patent survey is a fair criterion, it would require about three days to tie-in isolated claims. In case the locations were on so-called unsurveyed land, this time might easily extend to as long as ten days.

Reduced to dollars and cents, this means simply that in case the Bureau of Mines law passes, it will cost a prospector anywhere from $75 to $250 to make his location. This literally eliminates probably 95% of the pros-

pectors, for they are notoriously impecunious. Still *they do find the mines.*

The only good point in the new law is the one that eliminates the apex.

E. C. WATSON.

Luning, Nevada, September 25.

Indexing Current Technical Literature

The Editor:

Sir—May I add the following to my letter in your issue of September 17?

The 'Press' is not alone in its appeal for a complete index of technical articles, as witness the following editorial from 'The Iron Trade Review' of September 1, 1921:

"Announcement is made of the Index of Transactions of the American Foundrymen's Association, which has recently been published by that organization. The preparation of this book is an important achievement, and the directors of the Association are to be commended for their thoughtfulness and vision in authorizing the work.

"Although a great amount of valuable information has been contributed to the literature of the foundry industry, its usefulness has been seriously impaired by its inacessibility. Unless a person has had unusual facilities at his command, it has been difficult for him to obtain an extensive list of references on a particular subject. The annual indices of the transactions of the various organizations which touch upon the foundry industry are of little value in compiling a bibliography on a single topic, and the volume indices republished by the trade and technical papers likewise are not satisfactory in collecting references covering an extended period of time.

"The index prepared under the direction of the American Foundrymen's Association covers the vast number of technical articles appearing in all of the volumes of transactions of that organization that are in existence. Since it is the intention to revise the index at periods of about two years, it can be seen that foundrymen, metallurgists, and others interested, are assured of a complete bibilography which will be kept up to date. The book has the distinction of being the first of its kind to be published by a technical organization identified with a single industry. *It is to be hoped that other societies will find it possible to follow the example of the American Foundrymen's Association* [the italics are mine], and will compile indices which will open to engineers in other industries that vast amount of information which now is comparatively valueless because of its inaccessibility."

How well this applies to the mining profession needs no further discussion; it bears out your editorial on the subject. To enable this work to be accomplished, the Board of Directors of the American Foundrymen's Association at Pittsburgh in December 1919 gave its secretary, C. E. Hoyt, authority to engage a librarian to prepare a page-to-page index of all available volumes of its Transactions, there being from 9 to 29, inclusive, presumably 21 years. It is admitted that the tendency was to over-index rather than to cross-index too sparingly. An author's index forms part of the publication, as many engineers remember articles by author's names. The index is 6 by 9 in. size, 192 pages long, and is bound in cloth.

On further consideration of your editorial, and of what the American Foundrymen's Association has done, I do not think that an index for the mining profession could be compiled satisfactorily by voluntary effort, as is the case with 'Chemical Abstracts' of the American Chemical Society. No doubt able engineers could be selected—you gave Professor Probert a hint to busy himself on 'Outcrops'—but the best way would be to appoint somebody who knows what the mining profession requires; who understands mining and metallurgy generally; who has a knowledge of mining in foreign lands; and who is conversant with the technical press.

As I said in my previous letter, the American Institute of Mining and Metallurgical Engineers is the logical organization to do this work. It has access to a great technical library; it could circularize members as to the demand for an index; and could appoint somebody for the purpose. It would not necessitate any further call on members of the Institute, as the publication should be self-supporting.

M. W. VON BERNEWITZ.

Washington, D. C., September 20.

Valuation of Ore

The Editor:

Sir—Is there anything new or of value in the following method of estimating the value of placer deposits or the value of ore in a mine? Is the principle correct?

In order to ascertain how much a body of ore or a deposit of gravel will pay, it is first necessary to determine what is the lowest grade of ore or gravel it will pay to work. At first sight one is not likely to see how important or how difficult this is. If we work all the ore or gravel in sight we may easily work a lot of material that will not pay—a lot of material that will absorb a great deal of the profit that might otherwise be made out of the deposit. On the other hand, we may, if we are not careful, in an attempt to cut out ore that does not pay, leave ore that will pay. The problem is how to determine with certainty, instead of in an arbitrary manner, as is often done, the are or gravel that will pay. The lowest grade it will pay to work is always lower than the average cost of production, which is often taken as the basis of calculation. The average cost of production does not tell us how low we can go.

The lowest-grade ore or gravel that will pay to work is the grade, when worked at the same time and in connection with the higher-grade ore (worked as a side-line or a by-product), that will pay the wages of the men who take it out, for the tools they use, a portion of the wear and tear of the things they use in common with those taking out the higher-grade ore, and a fixed rate of in-

terest. No expense such as roads, houses, administration, superintendence, or plant, such as ditches, dams, flumes, mills, hoist, etc., should be charged up to the cost of taking out the low-grade ore or gravel. No expense should be charged other than the extra expense due to the extra production.

A deposit of gravel that will pay to work must have enough gravel above the value of the lowest grade to pay for equipment, current expense, and a fixed rate of interest.

Much of the expense will be incurred whether the low-grade is worked or not. You proceed as if you already had your mine opened up and your plant built and your organization formed. You proceed as if these had been given you free of charge. No past expense is considered, only the extra future expense is considered in figuring the lowest-grade stuff it will pay to work.

It is here assumed there are no limiting factors except those due to the orebody itself—no limiting factors such as the lack of capital, the lack of water, the lack of labor, the lack of fuel. A lack of capital to furnish the proper machinery and to do the necessary development work will raise the grade of the ore or gravel it will pay to work. The lack of water, of fuel, or of labor will do the same thing. What we need is the factor in determining the lowest-grade ore it will pay to work. Capital is essential, for it will do more than anything else to supply the deficiencies. This is a crude and an inexact way of putting it, but, I think, will give some idea of the principle. The idea here is much the same as that expressed by Mr. J. L. Bruce, in your interview with him, in which he says, "Any well-organized mining company is in a position to utilize its existing organization with comparatively small additional expense as compared with a new organization and with much better efficiency".

It is cheaper and more profitable to work this low-grade stuff while working the higher than to come back afterward and work it; it is cheaper and more profitable per ton or yard to work it than to exploit an entire deposit of equally low-grade stuff. It is a business proposition. It is a question of making the most efficient use of overhead expense. Business may be defined as the science of the overhead. In other business when it is desirable to know whether any side-line or by-product is paying or will pay, we deduct the expense of the business without these from the expense of the business with them. The difference tells the tale. In figuring the selling price the whole expense is distributed.

WM. CROCKER.

Prescott, Arizona, September 19.

Gold in Black Sand

The Editor:

Sir—I am gratified at the wide-spread interest in my work, as shown in the numerous letters I have received, and by Mr. Perret's contribution to your columns from Yokohama. I have just made this test: Seven pans of gravel gave 208 colors weighing 1½ grains, equivalent to $1.59 per cubic yard. I have found that taking medium scaly colors, discarding shotty colors, and fly-specks, they range from 213 to 1½ grains. We then rocked a measured cubic yard of material for 40 gr. ($1.50), which, allowing for an inevitable loss in rocking, is rather better than the pan.

We saved 46 lb. of concentrate in the clean-up, which contained 63.1% of non-magnetic material. Part of this was pulped; it assayed $1014.66 per ton in gold, platinum, and iridium; 63.1% ($640). A test of the tailing from the rocker showed a loss of over 50 lb. of black and gray sand, though of less value than the recovered portion, it is fair to take 50 lb. in lieu of 46 as the recovery, which gives an average of $16 per cubic yard that would be lost by ordinary placer-mining methods. I have found considerable precious metal in the red and gray sand, which is of almost the same specific gravity as the black sand, and this accounts for the large proportion of concentrate per yard.

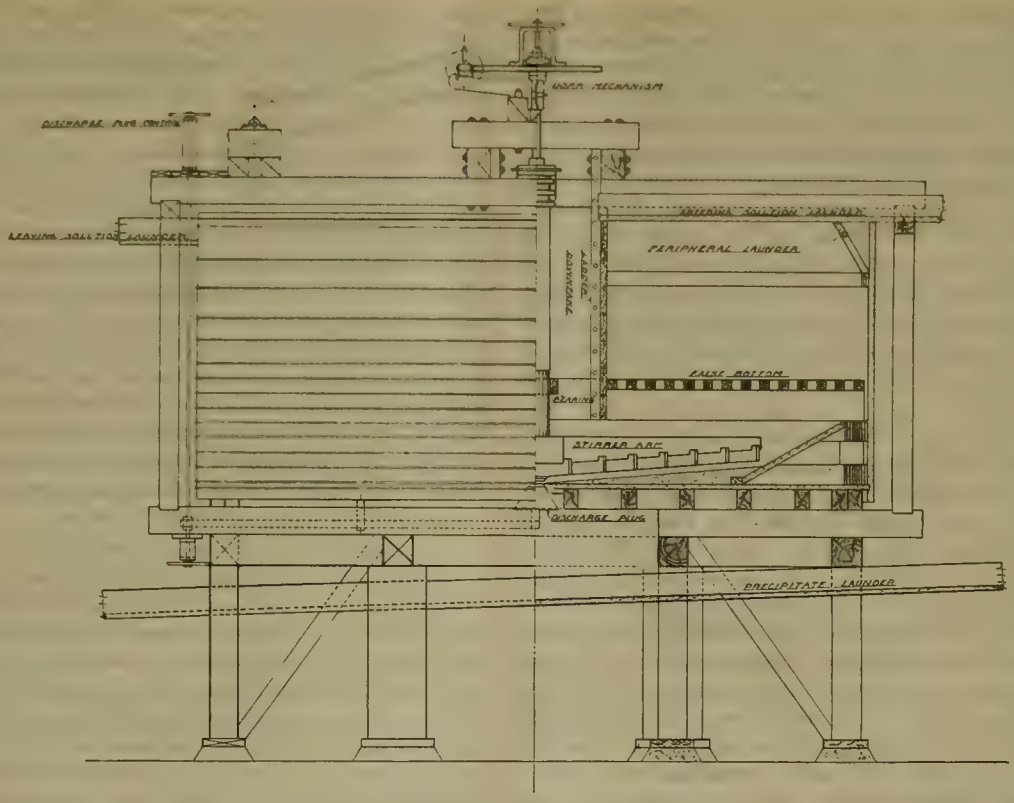
We have a big body of rich gravel, but are handicapped by lack of fall. We have to pump our water by electric power, so that economy is the first consideration. The bed of the present river is conglomerate, which rises under the bank to within six feet of the surface, 25 ft. above summer level, runs flat for a few feet and then dips and forms the bed of the ancient channel. This is about 30 ft. deep and carries 15 to 25 ft. of pay-gravel, with about 6 ft. of sandy loam as an overburden. As the result of months of careful experiment, we have decided to erect the following plant:

A Sauerman drag-cable elevator will be worked by an electric hoist; capacity, one yard per minute. The bucket will empty on an 18-in. grizzley, over a hopper feeding a 16 ft. by 4 ft. trommel with §-in. holes; the oversize to go to a conveyor for stacking, and undersize along a short length of flume with the usual riffles, to save the coarse gold, thence over two Neill jigs, which discharge to a tray with a Wilfley head-motion. Across one end of this a magnetic roller is spaced one inch above the material, and is revolved by a canvas belt. The magnetic sand goes to a short conveyor, and the non-magnetic to a 5 ft. by 3 ft. ball-mill, thence to a Senn pan-amalgamator, and over a Deister table. Roasting would give a better recovery of amalgam, but it would add greatly to the cost and complexity of the process, and break its continuity.

By passing this product over a table, what we lose on the swings, we will get on the roundabouts. All our power is electric, and on an output of 1000 yards per diem the estimated cost is 10 cents per yard. In designing the plant we gave no consideration to Berdan pans. I was under the impression they had been discarded in favor of ball-mills. I am inclined to agree with Mr. Perret that a Berdan would give excellent service on this type of material, and if one is procurable in the United States I would like to try it. This description is given in the hope that it may be of service to someone engaged in similar operations, and helpful criticism will be welcomed.

J. S. TAYLOR.

Rogue River, Oregon, October 1.



GENERAL ARRANGEMENT OF THE PRECIPITATING-VAT

Development of Copper Precipitating Apparatus

By Joseph Irving, Jr.

The first step in the development of the precipitating methods and apparatus, of which it is the object of this paper to illustrate, was taken at the Copper Canyon leaching plant of the Glasgow and Western Exploration Co., and was to a certain extent the outcome of a hurried adaptation of some apparatus that happened to be on hand, to overcome a defect in the original design of the plant.

The precipitating equipment of the Copper Canyon plant, as originally designed, consisted of a single launder, 4 ft. by 4 ft., 300 ft. long, divided into six equal sections of 50 ft. each, and set at a slope of 1.5%. Each section was equipped with a baffle and solution downtake at one end, and with a precipitate-discharge opening at the other, lower, end. The launder was fitted with a false-tray bottom, the top of which was set 7 in. above the bottom of the launder; this was so built as to hold the scrap-iron and to allow the precipitate to fall through and to collect on the bottom of the launder. The precipitate was removed by sluicing, with a strong force of water, into a small 12 by 12-in. launder, laid alongside the precipitating launder, and so conveyed to a settling-sump. The iron was cleaned by hand.

At the start of operations in 1912 the launder-precipitating system was found to be inadequate to recover the copper being produced. Because of the situation of the plant and because of the time needed to order and erect sufficient precipitating launders, it was decided to install temporarily three round vats, which happened to be on hand, at the lower end of the precipitating launder, and to fill them with scrap-iron. These vats, 20 ft. diameter by 8 ft. stave, were equipped with a false-tray bottom to hold the scrap-iron and to allow the precipitate to fall through and collect underneath. A solution downtake conducted the entering solution to a point below the tray bottom; a solution overflow launder was set into the side about 12 in. from the top, through which the solution left the vat. The vats were operated in series, and the results showed that a complete extraction of the copper was being made. As the operating costs were considerably lower than had been the case with the launder system, different sections of the latter were discarded, until the vats were recovering all the copper produced.

The efficiency of the vats led to experiments to devise a more satisfactory method of removing the precipitate than by sluicing out with water, the method first used.

Various devices were tried on both a small and a large scale, the one most favored, both for installation and operation, being the application of the Dorr-thickener mechanism to the vat, the arms of this being placed below the false-tray bottom, and rotated slowly, at intervals, to gather the precipitate to the centre and to discharge it through the opening in the bottom. This idea was adopted, and experiments were commenced on a large scale; but because of the liquidation of the controlling company, which took place about this time, the plant was closed down, and before the apparatus could be given a thorough trial. As the results obtained from the tests were satisfactory and promising, the idea was patented by me and the patent was assigned to the Dorr Company.

In 1916 I became mill superintendent at the copper-leaching plant of the Nevada-Douglas Consolidated Copper Co. At that time the plant, which was originally designed for the Rankin process, was being re-designed for the Westby SO_2 process. The method adopted for the recovery of the copper in the solution was precipitation on scrap-iron. Precipitating-vats, 20 ft. diameter by 10 ft. stave, equipped with false-tray bottoms and with solution downtakes, supplemented the launder system that was a part of the Rankin plant. It was thought advisable to erect only three of the vats at first, experimenting with them before equipping them with Dorr mechanisms, and before installing the other 10 vats that, it was estimated, would be required. As the process for the leaching of the ore was a new one, the different types of apparatus were erected and operated in units, so that mechanical defects could be rectified. This gave time in which to experiment with the precipitating-vat.

Experiments were carried out to determine the most efficient type of false-tray bottom, that is, a bottom that would allow the copper precipitate to fall through, but which would hold all but the smallest pieces of precipitant, and so prevent interference with the operation of the mechanism. A bottom built of 4 by 4-in. pieces of timber, set 4 in. apart in the clear, was found to give the best results. The provision of a peripheral-overflow launder increased the efficiency of the vat, due to the more evenly distributed upward flow of the solution through the iron and the absence of channeling. At first an ordinary Dorr-type launder was used, but was broken by the scrap-iron charged into the vat; and a new type of launder was developed. This is triangular in shape, with a smooth-covered top; it is built heavy enough to withstand the impact of the iron. The solution leaving the vat enters this launder through equally-spaced holes bored in the side; these should be set about 6 in. below the top of the vat, so as to be covered with solution. This launder provides a platform 18 in. wide around the outside; the operator can stand on this while arranging the scrap-iron in the vat. As the solution inlet holes in the launder are set below the level of the solution, any floating copper that is produced will stay in the vat until it is broken up and settles to the bottom. The shape of the launder prevents the slopping of the solution over the sides, during agitation, and also assists (in conjunction with the cone bottom in the lower section of the vat) in creating a flow of solution during agitation.

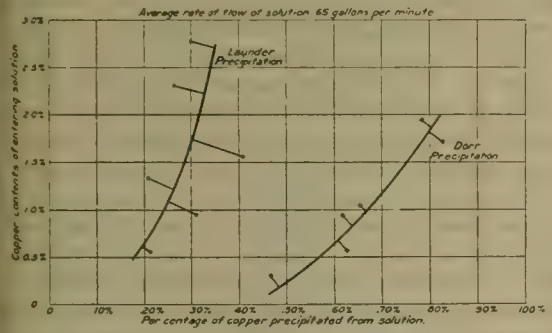
Experiments were also conducted to determine if it were practicable to agitate the solution in the vats sufficiently to wash the precipitate from the iron. Different methods were tried, such as (1) the use of compressed air, the air being blown in below the false bottom and allowed to bubble around the iron; (2) the use of a pump with a flexible-discharge connection, thus permitting a strong stream of solution to be directed into the iron; (3) the use of agitation, by mechanical methods, of the solution under the tray bottom. The use of air, although efficient, increased the consumption of iron and was expensive. The pump was found to be inefficient. The agitation of solution by mechanical means under the tray bottom gave the most satisfactory results.

An incomplete-cone bottom was added below the false-tray bottom to assist in gathering the copper precipitate toward the centre, and in order to give the solution, during agitation, an upward movement through the iron at the outside, and, consequently, a downward movement at the centre. This scouring action is governed by the speed of the mechanism, and can be regulated as desired. With the cone bottom and triangular launder, a velocity of the solution sufficient to wash the precipitate from the iron could be secured with a small power consumption.

The Dorr mechanism was found to be suitable to the incorporation of both principles in the one mechanism, provided that the arms were designed properly; two speeds were necessary, one high enough to cause sufficient agitation to wash the precipitate from the iron, and one slow enough to gather it after it had settled, and to discharge it. A method of precipitation that would avoid many of the customary losses was developed. The precipitate was discharged from the vats into a separator, where the coarse or heavy material was settled and the fine or slime precipitate was allowed to overflow with the solution into a settling-sump. The fine material was thickened in this sump and discharged onto a drying-platform, the drainage solution from this going to the sump-tank. The overflow solution from the sump-tank was returned to the precipitating-vats. This solution was also used to sluice the copper precipitate out of the vats being cleaned.

The precipitating capacity of the vats was investigated. The largest amount of copper recovered in one day was 7147 lb., from a 2.72% solution, the extraction being 99.5%; the best results for one week showed that 31,348 lb. of copper had been recovered from a 1.604% solution, the extraction being 97.7%. The iron consumption was low, averaging for one month 1.15 lb. per pound of copper recovered, and for the following month, 1.05 lb. Although this low consumption was due in part to the favorable character of the solution (from the SO_2 leaching-plant, in which a small amount of SO_2 was always present), the practical success of the innovations sug-

gested by the experimental work had much to do with the result. The difference in iron consumption during the two months was due largely to the avoidance of unnecessary washing in one case. It was unfortunate that financial difficulties, caused by the abnormal conditions prevailing at that time, necessitated the suspension of operations before the plant was completed. The experiments, however, proved the decided superiority of the Dorr vat over either the plain-vat or a launder system. Tests conducted on different solutions have shown that a plain-vat system will precipitate from 75 to 200% more copper than a launder system of the same capacity, depending on the copper contents of the solution being treated. Other tests have shown that agitation, such as is used in the Dorr vat, for the washing of the precipitate from the iron, results in a precipitating efficiency per cubic foot of from 50 to 100% above that obtainable in a plain-vat system, depending also on the copper contents


Average rate of flow of solution 65 gallons per minute
Launder Precipitation
Dorr Precipitation
Copper contents of entering solution
Per centage of copper precipitated from solution.

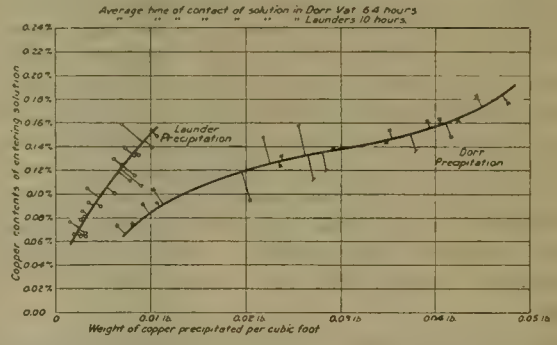
RELATIVE EFFICIENCY OF VAT AND LAUNDER ON HIGH-GRADE SOLUTION

of the solution, and the frequency of the cleaning of the iron precipitant in the plain vat.

Fig. 1 shows the comparative results obtained between vat and launder systems on both high- and low-grade solutions. Fig. 2 shows the general design of the Dorr precipitator. All parts that come in contact with the solution are made of wood, or some acid-resisting material. The Dorr mechanism has been re-designed. The low overhead clearance and the type of support shown interfere as little as possible with the charging of iron when this is done mechanically, as is the case when the gantry crane is used for this purpose. The heavy wooden extension shaft and the lower wooden bearing increase the mechanical strength of the mechanism, and decrease the length of unsupported shaft. The discharge plug can be operated from the top operating floor or from under the vat. This plug is the result of various experiments, and provides the most satisfactory method of controlling the discharge of the precipitate. The downtake in the centre of the vat is provided with a ladder, to enable a man to get under the tray bottom to repair the mechanism or to remove iron that may interfere with the operation of the mechanism.

The iron is placed on the false-tray bottom until it is level with the top of the tank; the solution enters through the downtake manway in the centre, goes to the bottom, and then up through the iron; it leaves through the overflow peripheral launder, into which it flows through the holes bored in the sloping side. A discharge launder takes the solution, either to other precipitating-vats or as waste. The solution-level in the vat is maintained constant by a baffle in the discharge launder, and should be kept a few inches above the inlet holes in the peripheral launder, in order to prevent losses from floating copper.

To wash the precipitate from the iron, the mechanism is raised off the bottom and rotated at a speed sufficient to ensure effective agitation. Although the amount and violence of the agitation required varies with the amount and quality of precipitate being produced, from one to two hours per day will generally be found to be sufficient. In a 24-ft. vat this speed is about 5 r.p.m.; about 4 hp. is required. The pricipitate is discharged from the vat


Average time of contact of solution in Dorr Vat 6.4 hours
" " " " " " Launders 10 hours.
Launder Precipitation
Dorr Precipitation
Copper contents of entering solution
Weight of copper precipitated per cubic foot

RELATIVE EFFICIENCY OF VAT AND LAUNDER ON LOW-GRADE SOLUTION, BASED ON WEIGHT OF COPPER PRECIPITATED PER CUBIC FOOT OF PRECIPITATING CAPACITY

by lowering the mechanism and by rotating it at a speed that will not unduly agitate the material on the bottom, but will plough it to the centre and discharge it through the opening there. The frequency of discharge will vary, with the amount of copper being recovered, from once a day to once a week. The length of time required to discharge the precipitate is about two hours; the power consumption will average about 0.5 hp. The plant shown in Fig. 3 is of simple design and economical in operation. The use of a gantry crane for the unloading of the scrap-iron from the railroad cars, and its later charging into the vats, reduces manual labor to a minimum. The adoption of the Dorr classifier and thickeners, and the returning of all the solution from this section of the plant to the precipitating-vats, reduces the loss of copper to a minimum. The pregnant solution enters the plant at either or both of the first two head tanks. Cross-connecting launders are arranged so that it is possible to operate the vats either in parallel or in series. The barren solution leaves the plant from either or from both of the last two vats. The cross-connecting launders enable any one of the vats to be cut out, without in any way interfering with the operation of the remainder. The precipitate is discharged to a Dorr classifier, where the coarse portion is separated from the fine or slime, the former being discharged onto the drying-

platforms and the fine overflowing from the classifier to the Dorr thickeners. The slime precipitate is thickened before being discharged onto the drying-platform. The overflow from the thickeners goes to a sump, from which it is pumped back to the precipitating-vats; pipe connections are arranged so that this solution may also be used to sluice out and clean the vats when necessary. The solution drainage from the drying-platform is collected in another common sump under the classifier, and is pumped back to the classifier intake, ultimately going to the precipitating-vats. The slime precipitate, which contains about 80 to 90% moisture, on being discharged from the thickeners, is left on the platform about 10 days, during which time it will have drained and dried to about 35% moisture. The coarse precipitate drains rapidly to about 15%. The precipitate is shoveled into small hand-cars, which can be run alongside the drying-sections; and is later taken out and dumped where required. The scrap-iron is brought into the plant in cars on the upper railroad track, and discharged by the gantry crane directly into the vats, or onto the scrap-iron storage floor, where the crane can later pick it up and charge it into the vats. It is advisable, for the handling of small scrap, to provide the gantry crane with a magnet. In those cases where the precipitate produced is in a coarse condition and where atmospheric drying is not practicable, a filter can be used to handle the product from the classifier and the thickeners.

The costs of a plant of this kind will depend on the type of construction adopted. A well designed plant, such as is shown in Fig. 3, will cost about $2 per cubic foot of precipitating capacity, completed. A comparison of costs between a launder system, a plain-vat system, and a Dorr system, using the same type of construction, will show that a plain-vat system is cheaper, per cubic foot of precipitating capacity, than a launder system; it is also cheaper per cubic foot than a Dorr system. But the increased precipitating efficiency of the Dorr system, enabling the same amount of copper to be recovered in a smaller plant, will more than offset this difference in first cost, making it not only more economical to operate, but also cheaper to erect.

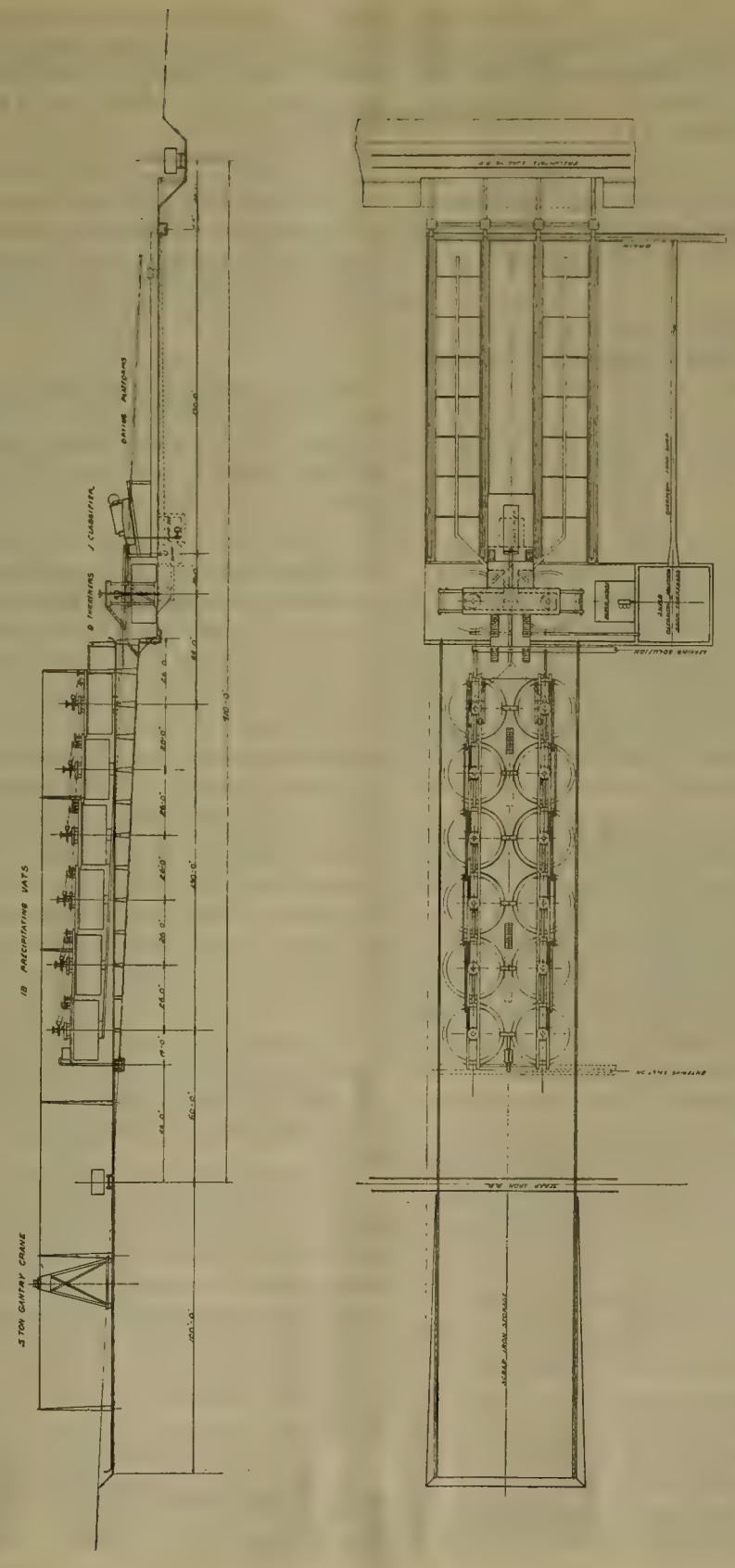
The amount of labor required will vary with the amount of copper being produced, and with the copper contents of the solution being treated. In a plant recovering, say, five tons per day from a 1% solution, and of approximately the same size as the one shown in Fig 3, five men per shift will be sufficient—one foreman, one man for the classifier and thickeners, one man attending to the precipitating-vats and the gantry crane, and two general laborers to assist in handling the iron and in loading the precipitate. With a smaller production of copper, but with the same quantity of solution being treated, the labor required would be proportionally less.

The consumption of iron rises above the theoretical because (1) of the iron-consuming elements in the solution other than that of the compound containing copper; (2) because of the oxidation of the iron when it is exposed during washing or cleaning; (3) because of the removal of the fine scale on the iron when it is being cleaned by scrubbing or by washing with a strong force of water; (4) because of the oxidation of some element in the solution and its reduction by the iron precipitant while the solution is still under treatment for the recovery of its copper.

The first cause is, to a certain extent, fixed and uncontrollable. The second results in a heavy consumption of iron in the plain-vat system or in the launder system, but is largely overcome in the Irving-Dorr system by the adoption of agitation to free the precipitate from the iron; the loss due to fine scale is also almost entirely avoided, for although the agitation is sufficient to free the copper, it is not violent enough to remove the small iron scale. The oxidation of some element in the solution and its subsequent reduction by the iron is the cause of a large proportion of the consumption of precipitant. The oxidation of ferrous sulphate to ferric sulphate and its reduction by the iron to ferrous sulphate is common; it is due to exposure of the solution and the iron to the atmosphere. It is, of course, dependent upon the amount of solution exposed and the conditions under which it is exposed. Agitation by which air is absorbed by the solution is especially effective; this occurs to some extent in the downtakes of a launder system. It is also marked in the case where violent agitation and alternating exposure of the iron and solution is adopted to facilitate precipitation. In the Irving-Dorr vat this oxidation is almost entirely avoided; there is a large volume of solution in the apparatus of which only a small surface is exposed. The amount of agitation required is small; the solution reaches the surface in the form of a swiftly-moving stream; the surface exposure of the solution is only slightly increased by the agitation.

The tests showed that the finer the precipitant the greater will be the iron consumption, other conditions being the same. Small machine shavings of a metal will show a higher iron consumption than would be the case if one large piece were used. It was also found that different metals have different precipitating efficiencies; their ratio of iron consumed to copper recovered will vary. Further, the percentage and grade of coarse precipitate to fine precipitate depends on the class of precipitant used; the grade of precipitate varies with the ratio of coarse to fine, the material with the highest amount of coarse being the richest in copper. The coarseness and the grade of the precipitate also varies with the particle size of the precipitant used; large pieces of a metal gave a coarser and higher-grade precipitate than would result from the use of machine shavings of the same metal.

Hydraulic classification was used to determine the ratio of coarse to fine in the precipitate, the portion that settled readily in a dilute pulp being designated coarse. Thus it is possible to determine approximately what portion of the precipitate will be separated in the classifiers and what portion will go to the thickeners. The coarser the precipitate the cheaper will be the recovery and han-



TYPICAL GENERAL ARRANGEMENT OF AN IRVING-DORR PRECIPITATING PLANT

dling costs at the precipitating plant, and the smaller the losses from transportation. The subsequent smelting and handling costs will also be less and the losses from dust will be smaller. It follows, therefore, that the coarse product is the more desirable.

The following table of results show clearly the different precipitating efficiency of the metals tested, their ratio of iron consumed, percentage of copper in the precipitate, and the ratio of coarse to fine precipitate, with a solution containing Cu, 2.4%; $FeSO_4$, 2.8%; $Fe(SO_4)_3$, 0.3%; Al_2O_3, 1.6%:

Precipitant	Ratio by weight of iron consumed to copper precipitated	Ratio of coarse to fine	Precipitate, % Cu
Pig-iron	1.35 : 1	98 : 2	94.4
Wrought-iron .	1.6 : 1	94 : 6	87.2
Cast-iron	1.65 : 1	93.5 : 6	86.8
Steel shavings.	2.10 : 1	86.5 : 13	72.7
Cast-steel	1.75 : 1	94.1 : [illegible]	80.1
Tin cans	2.35 : 1	81 : 19	66.9

The tests prove that the grade of precipitate varies approximately with the amount of iron consumed. The ratio of coarse to fine in the precipitate also varies in the same manner; the greater the proportion of coarse, the higher the grade of the precipitate. Although the quantity of slime produced is governed largely by the character of the solution, agitation will result in increasing the amount. In tests where violent agitation was adopted to facilitate precipitation, the precipitate produced was in a very finely divided state, and the ratio of slime was excessive.

The use of scrap-iron for precipitation, both for the recovery of copper from mine solutions and as an adjunct to metallurgical processes is increasing; it is apparent that a more satisfactory and dependable supply of such a precipitant must, in the near future, be available. A source which would be supplemented by the small amount of general scrap, such as is used at present and will always be procurable around the plants and small towns where precipitation is practised, would be the most desirable. Pig-iron, because of low precipitant consumption, high grade and coarse condition of precipitate, is the most economical.

The use of a small cupola furnace at an adjacent smelter, in which calcines, heavy in iron, could be smelted for the production of pig-iron, would offer a satisfactory solution of the problem. It would not be necessary to produce a high grade of pig, or to separate the copper or fine metals in the calcines, as these would ultimately be recovered. The cost of producing this pig-iron should be low, and, even on a small scale but under the conditions that should prevail in normal times, should not exceed $15 per ton.

There is no doubt that methods will be developed that will supplant iron as a precipitant in some cases; but in view of past developments it is also probable that its general use will increase rather than decrease, because of the perfection of new methods and processes. The Dorr vat, and the method of precipitation described, do not constitute a panacea for all the ills attendant on the precipitation of copper from solutions by scrap-iron. The results of a large number of tests, however, show that success has resulted from an effort to adapt mechanical methods to what has been a sloppy and messy operation, and one in which the labor requirements have been excessive. During both the development of the idea and its practical operation every effort was made to avoid new and untried methods and to refrain from any radical departure from well-known and accepted principles; the results are such that there is no necessity for costly experiments before the apparatus and method can be adopted elsewhere.

WITH the strengthening of diplomatic and commercial ties between the United States and Venezuela, the improvement of the existing railroads of the latter country and the building of new lines are brought definitely nearer. There are at present twelve railroad systems in Venezuela, with a combined length of 600 miles, and $40,000,000 of invested capital. In addition, the building of four new railroads is being considered. One of these would connect the cacao region with the coast, the second would run through cattle, coffee, cacao, and tobacco lands, the third would bring the product of the country's oilfields to a deep-water port, and the fourth would make it possible to ship machinery to the Yuruari gold mines, which are now being worked only in a primitive way, and at the same time would tap grazing lands and iron-ore deposits. American capital is welcomed in Venezuela by the Government, which is pursuing a liberal policy toward foreigners. Recent laws guarantee railroad builders against the construction of rival lines paralleling their routes, and against oppressive taxes. Railroads are assured of a fair proportion of unclaimed lands, of the right to erect telegraph and telephone lines, and of the exemption of their employees from military service except in the case of international war.

The following table shows the amounts of lead and zinc pigments marketed in the United States in 1920, with the value and average selling price of each, compiled from reports made by producers to the U. S. Geological Survey.

As compared with 1919, an increase in the quantity sold was shown by every product except zinc oxide, in which there was a loss of 15%, but the average price per ton of zinc oxide showed a slight gain. There was also an increase in the average selling price of the other pigments. The greatest gains in 1920 were made by litharge, in which the gain in sales was 33% and the gain in average price per ton was $61.11, or 44%.

Lead and zinc pigments marketed in the United States in 1920:

White lead:	Quantity (short tons)	Value	
		Total	Per ton
Dry	33,678	$6,351,798	$188.60
In oil	112,017	25,986,100	231.98
Red lead and orange mineral....	34,431	7,523,089	218.50
Litharge	62,329	12,386,185	198.72
Zinc oxide	99,444	17,859,736	179.60
Leaded zinc oxide	30,460	4,467,532	146.67

Status of the Metal Mining Industry: An Interrogatory

The business department of the 'Mining and Scientfic Press' recently issued an interrogatory to a number of engineers specially qualified to testify on the subject. This is the second part of the replies; the first appeared last week; the last will appear next week.

COPPER

Question 1: When do you expect a general re-opening of the copper mines? Please name approximate date.

"I believe that the mines that can produce copper refined f.o.b. New York for 10c. will start up before the middle of next year."

"It is impossible to guess at the date for re-opening of the copper mines, since this depends entirely on general conditions in this country and Europe."

"Personally, I don't expect a general re-opening of the copper mines before July 1, 1922."

"I anticipate that there will be no common date on which there will be a general re-opening of the copper mines of this country. Two very important factors will govern, one being the stocks of marketable copper on hand and the other the relative cost of production. These vary for every producing company of the United States, and will obviously control in each instance the date of their resumption of productive operations. As it requires approximately ninety days for transportation from Western smelters and for the refining, it follows that production will necessarily have to commence when the producer's stock of marketable copper is reduced to what he may estimate as his prospective sales for the coming three months. As regards the price of copper, even with the present surplus reduced to a basis of three months production, the estimated selling price must necessarily be the controlling factor in each instance. It is obvious that the mine whose copper costs 15c. to produce will not be inclined, even if its surplus stock is practically exhausted, to re-open on a 13 or 14-cent market."

"In about six months mines should begin to resume operations."

"I have no opinion to express relative to the re-opening of the copper mines, as this will depend entirely upon the condition of the copper market, which in turn is dependent, in my judgment, largely upon conditions abroad and the resumption of business activity in this country."

"The sales of copper in the past few months have been most unsatisfactory. When we closed down in April, I had hoped that we would start up in November. I cannot see now how we can start up before the first of the year, and I believe if we start up then it will be because of the crying need to give employment. I am of the opinion that we could remain closed down otherwise to good advantage until well on into the spring."

"It is idle to try to fix a date for the general re-opening of the mines. I can see no possibility of its happening before March first and it will probably be much later."

"I know of no method whereby the date of the general re-opening of the copper mines can be determined. There are altogether too many variables mixed in this situation, and as far as I know there is no precedent upon which to base any forecast. The copper industry is simply dependent upon the general resumption of business activities in this country and in Europe, and it appears that some time within the next year this activity should manifest itself."

"It is my opinion that this will not occur until after the end of the current year. I believe operations will be resumed to some extent about the end of the first quarter of 1922. The scope of such resumption, as compared with capacity, is something about which I believe no one can more than guess, but I may say, in a general way, that I do not expect that production will be warranted generally to more than somewhere between 50 and 75% of normal capacity for at least twelve months following the date of partial resumption."

"I do not think that even an approximate date can be set for a general re-opening for the copper mines. It depends upon the rapidity with which the metal market improves and this in turn is dependent upon the recovery of industry generally from its present extremely depressed condition."

"I have no opinion on this point."

Question 2: Are the managers of existing properties taking advantage of the opportunity afforded by the shut-down to consider ways and means of reducing operating costs through the introduction of more modern and more economical equipment? Please give such particulars as you can.

"The managements of many of the mines in this State are indifferent. We are centring all our endeavors to

get the cost of the running of the State of Arizona reduced for the year 1922 to one-third of the cost of last year, and of securing a 54c. rate on oil from Oklahoma and Texas to ——, a $5 rate on bullion from —— to San Pedro, and a reduction in the rates on mine timbers from sawmill points in Arizona and San Pedro to ——.

"The people of the State of Arizona have gone wild on extravagance. The appropriations passed by the last legislature for State government alone exceeded the appropriations of the former legislature by a million and a third of dollars. Road bonds have been issued and sold and are returnable as to principal and interest, and the total cost of running the State, municipal, and county governments for the year 1921 will exceed thirteen million dollars. The per capita cost for the United States government is something over $6. The per capita cost of Arizona is $24. Hence, the necessity of the mining companies and of others who so largely in this State depend upon the mines for a living centring on the reduction of the present extravagant habits in order that copper may be mined, reduced, refined, and sold at New York for 10c. Several of the mines in this State can reach this figure if they make up their minds to it."

"Managers of existing properties are generally considering methods of reducing operating costs through introduction of more modern and more economical equipment, but the financial condition of the companies makes it impossible to make such improvements at present."

"The managers are taking advantage of the opportunity afforded by the shut-down to make improvements looking to a reduction of operating costs.

"The —— Copper Co. is preparing to sink a new shaft and equip the same. They are also busy with plans for a large leaching-plant to handle their oxide ores. They are making other improvements of minor character tending to reduce costs. You doubtless have received information about this direct from company headquarters.

"The —— Copper Co. contemplates changes in its mechanical equipment, including rehabilitation of the crushing and concentrating plant, the addition of a bedding system for reverberatory fines at the smelter, and the addition of high-pressure boilers in the power-plant, the total to cost around $500,000, with possible economies that would return the money in two years operation."

"Believe majority of mine managers and metallurgists are considering methods of reducing operating costs and improving recoveries. Believe study is being made of systems of mining for the purpose of determining which is best applicable in each particular property, and in the case of metallurgy, understand new flotation agents will result in better recoveries and that improvements in flow-sheet will reduce costs."

"The managers of all properties, I believe, are at all times considering ways and means of reducing operating costs, through the introduction of more modern and more economical equipment, as has been evidenced in concentration by the almost universal adoption of the flotation process."

"To some extent. Managers are always considering ways and means for reducing costs. At some of the older plants capital expenditures are being made, or are about to be made, to decrease costs. This is notably true at Bisbee, Cananea, and Nacozari.

"The Clifton district also faces heavy capital expenditures for milling the great tonnages of lean ore that have been opened up in recent years.

"All these improvements are not so much made because of the close-down as because plants have become gradually worn out, or because conditions have changed, or both. Recent advances in mining and metallurgical methods have converted large tonnages of copper-bearing rock into marginal material. Those mines that have this material are in some cases preparing to utilize it."

"The managers are considering the reduction of costs by the introduction of more modern and economical equipment, but it is doubtful whether their stockholders will consent to any large construction campaign at the present. It is always much more difficult to secure appropriations for such work in dull periods and in most cases the changes made will probably be of minor importance. So far I have heard of no decisions to make large improvements."

"I do not know that any of the copper producers are making any more effort at this particular time to reduce operating costs than they have in the past, for all progressive managers certainly have this point in mind at all times. There are some plants that I know of that are making improvements that could not be made while operating, and to that extent these particular properties are obtaining a benefit through the shut-down because they are able to make improvements that otherwise could not have been made without loss of output."

"At the properties operated under my direction such activities are being continued in a limited way and with respect only to details of improvements, affecting the metallurgical facilities principally, which were under way at the time of suspension."

"I am of the opinion that most of our producers are taking advantage of the shut-down to prosecute development work and preparation for extracting their orebodies economically, as well as modifying their mill flow-sheets, and, in some cases, increasing the capacity of their concentrators and their smelting plants."

"In the case of the —— Co., regarding which only I can speak with authority, not only has active development taken place in the limestone mines of the —— Co., but the disseminated deposits are being stripped of their overburden and put in shape for production early in

1922. There is also nearing completion a 4000-ton concentrator in order to treat these disseminated ores. At the —— Copper Co., the flow-sheet of the mill is being changed and provision made for increasing the tonnage from two to three thousand tons, while extensive improvements are being installed at the mines in order to reduce the cost of producing ore."

"I do not think that much new equipment is being installed. In our own case we have endeavored to keep our equipment up to date, and I do not know of any changes we can make which would yield any material additional economy. I think this has been the policy of practically all of the prominent producers. However, even if there were items of equipment that I would like to install it would not be done now, since prices of machinery and equipment generally have not dropped as much as they should and I think can be purchased for less money later on."

"My experience is that managers of copper properties are continually endeavoring to reduce operating costs. As a whole, copper mining is a fairly efficient industry and it is not expected that any sudden improvements can be made. It is a slow growth and development."

Question 3: What steps are being taken, if any, by the copper producers toward the inauguration of a campaign to increase the use of copper in the arts and crafts?

"The Copper Research Association."

"The newspapers are announcing the formation of a copper and brass research institute for the promotion of the use of copper."

"I know little of activities of the copper producers toward the inauguration of an advertising campaign to increase the use of copper in the arts and crafts. However, the —— Copper Co., through —— efforts, is experimenting with methods for manufacturing copper articles direct from solutions produced in their leaching process.

"A few decades ago the builder had shingles, slate, terne plate, or copper to select his roofing material from. Since then asphaltum and coal-tar products have been developed and applied. It is a process of evolution. There is no more reason to go back to the copper roof as of old than to go back to the flag-stone sidewalk. If there is any place where a copper roof is justified I think a copper smelter should have it, but there are none in existence (except some experiments). There is no more copper in the world than is required in its perfectly legitimate field of usefulness. It is indispensable in industry and the trouble is mostly with industry. It would be a waste of metal to use it more universally just to create a market for it. The public should not be *asked* to 'buy something made of copper'. Copper is not a mendicant among metals. It doesn't appeal for public alms, but the public might profit by becoming better acquainted with its many virtues, and these might be advertised."

"Have recently noted formation of the Copper and Brass Research Association, which is composed of the principal copper producers in the country. I understand the object of this research corporation is to find new uses for copper."

"Both copper producers and consumers are very active in inaugurating a campaign to increase the uses of copper in the arts and crafts, through the Copper and Brass Research Association, which has recently been formed, and with which your are doubtless familiar."

"I am not as well posted on this subject as they are on the selling end. I believe, however, that the producer cannot permit the fabricator to pursue old-fashioned methods of manufacture and salesmanship and at the same time use his, the producer's, stockpile as a warehouse to draw from as convenient. The producer's stock might just as well be fabricated and on a hardware shelf or in a plumber's shop as lying idle in a stock pile, and if the former were the case the producer would automatically have a great increase in the number of interested salesmen. I am inclined to think the producer may be forced to become a fabricator, using modern methods and modern machinery and seeing to it that his wares come direct to the consumer and that their value is impressed upon the consumer."

"The producers are forming a Copper Research Association to promote the use of copper but the high prices charged for copper and brass products still hampers the sale of them to the general public. Ultimately some of the large producers will be compelled to go into the fabrication of copper and brass products to stabilize the copper market but aside from what has been done by Anaconda, I do not know of any decision to do this now."

"The producers and consumers of copper are making every effort to foster a campaign which would popularize the use of copper in the arts and crafts. So far this effort has crystallized in the organization of a copper and brass research committee with headquarters in New York, and with this as a nucleus I presume larger things will develop."

"Active steps of this nature are being taken through the Copper and Brass Research Association, recently organized."

"The copper producers, together with a certain number of the important fabricators, have joined in a voluntary association, entitled 'The Copper & Brass Research Association', to investigate the uses of copper and its alloys

and to educate the public to the merits of the metal. It is expected that ultimately, after certain research work has been concluded, a campaign of publicity and advertising will be inaugurated, and it is hoped that the consumption of copper per capita in this country can be greatly increased."

"The Copper and Brass Research Association, announcement of whose formation was recently made, has for its object stimulation by co-operative effort of the use of copper, brass, and copper-alloy products."

"The copper producers, in conjunction with the brass people, have, as you probably know, organized a Copper and Brass Research Association, of which W. S. Eckert is the secretary, his address being Room 1903, 25 Broadway, New York. The object of this Association is, by advertising and other legitimate means, to increase the use of copper and brass and to combat propaganda which may be issued by the producers of other metals seeking to replace copper."

Question 4: What class of mining, milling, and smelting machinery is least satisfactory in the performance of its function, and in what respects should it be improved?

"Mechanical equipments are as up to date as in any other industry in the country and much saving in the reduction of labor is not easy to readily see."

"The mining machinery which is least satisfactory is the mucking machinery. A mucking machine which will handle both fine and coarse material without excessive repairs has not as yet been developed. The milling machinery which is least satisfactory is the intermediate crushing machinery between gyratories and roller or ball mills. The existing intermediate crushing machines give excessive repair costs on hard ores. The most unsatisfactory smelting machinery is that for the collection of flue dust without excessive cost for reduction of velocity and temperature of gases, and the machinery for treatment of flue dust."

"There is still room for improvement in the machinery used for crushing ore, particularly in screening between stages.

"The industry also awaits the man who can develop a greatly improved method of removing water from flotation concentrates. The best the present vacuum apparatus can do is to make a putty-like mass which is most difficult to handle. The use of heat in reducing the moisture—thereby making the product satisfactory to handle—is ordinarily too expensive. In most flotation plants the settling and filtering apparatus requires greater area and nearly as much attention as the rest of the mill, and the 'tail will continue to wag the dog' until somebody makes a big improvement in the filtering end of the business."

"Am unable to state what class of mining, milling, and smelting machinery is least efficient, but there is probably room for improvement in all."

"I do not think that I could concentrate upon any particular form of machinery that requires improvement."

"Mining, milling, and smelting machinery are keeping up with progress pretty well. The Smith-Pierce converter is passing the upright converter in efficiency partly because of less mechanical loss. Mechanical loss generally needs further study, especially in the older plants. The utilization of streams for power and its transmission will be badly needed as the supply of fuel oil decreases, and I believe other substitutes will have to be provided for fuel oil as a smelting fuel or new processes devised.

"A subject that worries me more than machinery and smelting methods is a proper treatment for lean, mixed sulphide and oxidized copper ores. Lean ores have necessarily far narrower margins and dual processes are objectionable. It is simply a case of increased costs to be more than counterbalanced by increased recovery.

"Progress has been made in the treatment of thoroughly oxidized ores by wet methods. I am inclined to believe that there is a broad field and an urgent need of a study of wet methods as applied to these mixed ores."

"Your fourth question covers a rather large field but I would call attention to the fact that the pump manufacturers of this country have so far failed to perfect the centrifugal pump to anything like the extent that this has been done in Europe. The small space required and the small amount of attention necessary give this pump a very decided advantage over the reciprocating type for mine use but its low efficiency makes the cost of operation prohibitive in large installations."

"This is a very difficult question to answer without going into a complete detailed discussion of each operation, which I presume was not the object of your inquiry."

"It is my opinion that for a long time screening or sizing apparatus, and particularly that designed for fine screening or sizing, has been the outstanding class of least satisfactory apparatus in mining and metallurgical industries. It may be said, however, that in recent times the necessity for fine and accurate sizing has decreased very markedly, and especially so as pertaining to wet sizing, this having come about through the extending use of flotation processes."

"This is a difficult question to answer, as it varies with each particular class of ore, and each individual producer has his separate and distinct problems."

"The selection of mining, milling, and smelting machinery is governed by the character of the ore deposit to

be mined or character of the ore to be milled and smelted. I think that satisfactory machinery is available for almost any operations and cannot think of any one class that is at present unsatisfactory. An improvement in stoping drills would be the development of a satisfactory drill with water feed to keep down the dust."

"It is impossible to give any answer to this question because there are few managers who are employing machinery which they think is unsatisfactory. Of course in certain cases as the art advances improved machinery is not always put in immediately, as it is more economical to wear out the old. In the new crushing plant of the —— Copper Co., which we have just started at No. 5 shaft, we have so laid out the work that we have been able to eliminate bucket elevators and replace them by gently inclined belt-conveyors. We have also eliminated trommels and replaced them by new types of vibratory screens, one section being equipped with Mitchell screens and the other with Hummer screens."

Question 5: Is there a tendency to substitute mechanical for hand labor wherever possible, and for what particular class of work?

"Mechanical devices are being substituted for hand labor wherever possible; especially in the handling of ore."

"There is a tendency in the United States to substitute mechanical for hand labor wherever possible. In Mexico there is more of this than before but less than in the United States. The big mining companies are continually improving their mining methods and are experimenting with mucking machines, etc. They are quick to take up any mechanical device that will lessen costs."

"All mine managers have always been striving for means for reducing hand labor and since the time of great increase in rates of wages and loss of efficiency by laborers, additional efforts have been made to reduce to a minimum all hand labor."

"There is always a tendency to substitute mechanical for hand labor, especially in handling rock underground, and I think that nearly all of the large mining companies have been endeavoring to get mechanical shovelers, but thus far few of those invented stand the wear and tear of underground work, and on account of limited space underground in narrow drifts, it is impossible to use the mechanical shovelers of greater strength."

"There have been few radical changes in process, but these stand out like beacons in the metallurgy of copper. The most notable are the introduction of the converter, the introduction of flotation, and the beginning of wet methods of extraction of copper from oxidized ores with the production of refined copper. During the past 20 years there has been a tremendous advance in increasing the size of units and decreasing the cost of handling materials through the introduction of mechanical methods, and this tendency continues and always will continue.

"It was easy to introduce cheaper methods of handling material in metallurgy because metallurgical processes are conducted on the earth's surface. It was much more difficult to introduce mechanical methods underground, but with changes of mining methods and increase in the size of units, together with mechanical traction, great improvements have been and are being made underground with a tremendous increase in the tons produced per man per shift. There is still room for great development in this direction."

"There is a strong tendency to substitute mechanical for hand labor, notably in shoveling. The mechanical shovels I have had experience with give encouraging results but are still in an experimental stage and will have to be greatly improved in design. Power haulage has already supplanted hand tramming to a very large extent but there remains much to be done in the development of satisfactory cars and unloading devices."

"Yes, for every class of work without exception."

"I think there is a universal effort being made to substitute mechanical for hand labor wherever possible, not only in the mining of ores but in the subsequent handling at concentrators and smelters."

"It has been for some time past the policy of many companies to substitute mechanical means for performing work wherever it can be done economically. One operation which is receiving considerable attention at present is mechanical mucking. As over half of the underground labor in deep mines is employed in handling the rock after it is broken, there would seem to be an important field here for developing mechanical contrivances to do the work."

"The whole tendency in modern mining, concentrating, and smelting is to substitute mechanical for hand work wherever possible. In mining the porphyries, the general tendency is toward some caving or shrinkage system in which the ore runs down into chutes and from there loaded into electrically operated cars. In certain methods an intermediate tramming with the use of hand cars is resorted to, but the haul is not long. In the Lake Superior copper mines, particularly those having a flat dip, there is a tendency to introduce mechanically operated scrapers which pull the ore, or 'rock', as it is locally called, down the stopes onto a shelf or platform, from which it is pushed into the cars. In the Lake Superior copper mines hand-tramming is gradually giving way to tramming with electric locomotives, some being operated by trolleys and others by storage batteries. This results in the cutting down of the number of shafts necessary to exploit a piece of ground, as when hand-tramming was used it could not be extended over

long distances, and hence the shafts had to be close together."

SILVER

Question 1: Is silver mining recovering by reason of the general lowering of the cost of production?

"Yes."

Question 2: Is the operation of the Pittman Act a sufficient incentive toward increased interest in prospecting for and development of new silver properties?

"Yes."

Question 3: Is the present lull in the production of copper stimulating the operation of silver mines by reason of the cessation in the production of by-product silver?

"No."

Question 4: Are the managers of existing properties considering ways and means of reducing operating cost through the installation of more modern and more economical equipment?

"Yes."

Question 5: If the answer to No. 4 is 'Yes', please give such particulars as you can.

"UNDERGROUND. The use of better drilling machines. The use wherever possible of mechanical shoveling. Substitution in part of 'hand tramming' by electric motor haulage.

"MINE-SURFACE. Greater use of machine drill sharpeners."

Question 6: What class of mining and milling machinery is least satisfactory in the performance of its function, and in what respect should it be improved?

"This is too broad a question to answer by a letter of this nature."

Question 7: Is there a tendency to substitute mechanical for hand labor wherever possible, and for what particular class of work?

"Yes; mucking and tramming."

(To be Concluded)

A BRITISH aluminum company, in a brochure which it has issued dealing with the use of aluminum for bus bars and interconnections in electric-power stations, claims that aluminum secures a more complete economy than the substitution of bare copper rod or bar for insulated cable, states a consular report. It claims that the use of aluminum results in considerably reduced initial costs, greater ease in erection, smaller temperature rise for equal inductance, and less weight; also slower temperature rise under temporary heavy increases of load and greater resistance to corrosion. The company urges that on the basis of conductivity, an aluminum conductor of the same resistance and length as one of copper will have a cross-sectional area greater in the ratio of 10 to 6, whereas the weights will be roughly as 1 to 2. With heavy currents an aluminum bar, because of its greater perimeter, will have considerably lower temperature rise than a copper bar. When prices of the two metals are such that for equal resistance aluminum shows a cost saving of 15%, the equivalent cost saving with heavy-current conductors will be from 25% to 30%.

Diamond Industry

A new impetus is manifest in the diamond market of Antwerp, which is one of the most important in the world, and certainly the most important in diamond cutting, states a consular report. This impetus, due to a sort of willingness to trade at any price, is local, reports from other centres being still less favorable. At the same time, the big merchants and dealers are optimistic and unanimous in predicting a general resumption of activity. For about two months the supply of diamonds from Russia had apparently ceased, when suddenly a parcel of several thousand carats was again negotiated on the market. A considerable portion of this lot had to be re-cut. Besides these Russian stocks, the importance of which has been overestimated, the market seems to have been further unfavorably influenced by contraband and smuggling, which have been on the increase since the signing of the Armistice. It is thought by some merchants that the Government could intervene to advantage by placing on stones presented for re-cutting a duty of, say, 20%. Such a measure, however, besides being difficult of application, would be inoperative unless adopted by all countries. The measure taken in one country only would result in favoring cutting establishments in neighboring countries. Antwerp would then remain exposed to the disagreeable duty of smuggling so long as the situation did not improve in Russia and Poland, where persons in need of funds sell their jewels at low prices. At present, therefore, it is difficult to give the carat a correct value.

In South Africa, after the monthly output had reached 9424¾ carats, valued at 1,925,000 francs, the lowest registered since the crisis of 1907, the exportation of diamonds has apparently taken an upward turn. A notable event during the months of the crisis was the discovery of a 381-carat stone at Gong-Gong. The story of this find is to the effect that three men obtained a concession in the new bearings of Mosesberg. Arrived at Barkley West, they unhitched and their mules strayed off. Not being able to continue their journey the men determined to try their luck on the spot, and it so happened that they found on an abandoned concession this 381-carat diamond, the greatest discovered on the river.

The carat, which was worth £17 4s. ($83.59 at normal exchange) at the beginning of the year, has dropped to £10 7s.3d., reaching, it seems, its lowest level. In June a real advance was shown, 12,322 carats being exported, representing a value of about 3,000,000 francs.

Scheduling Mine-Operations to Suit a Power-Contract

By B. B. Beckett

*Introducton. The title of this paper is a little too broad in that the term 'metallurgical plant' should be restricted to the ordinary mill found in connection with mining enterprises in the West. It should not include such plants as iron and steel mills, electro-chemical plants, smelters, or copper refineries. My experience has been chiefly in gold and silver mining, particularly at Goldfield, Nevada.

Most power-contracts or rate-schedules for mining companies contain some sort of load-factor provision. These vary widely; they are sometimes illogical; and it may be that a better understanding on the part of power companies as to what mining companies can economically do in the matter of controlling their load-factor will result in more reasonable provisions in the contracts.

Characteristics of 'Mine-Loads'. The load-factor of mining enterprises is high even without any effort to make it so. A mill-load is nearly constant for 24 hours per day and for about 363 days in a year. A mine-load, considered separately from the mill, is not so good, but still much higher than most industrial loads. When the two are combined, as is usual, the resultant load-factor is very high, since the mill-load will predominate, being usually three or four times as great as the mine-load, measured in kilowatt-hours. The load-factor of a mine and mill, based upon the maximum 30-min. kilowatt-hour demand per month will be about 70% even if no control is exercised, and may be made as high as 90% by careful scheduling of operations.

The one difficulty with mine-loads is the induction-motor hoist generally used. Hoists cause violent load-fluctuations of short duration, but do not materially affect the load-factor as based upon a maximum demand for 30 min., or even for 5 min.; and the objection to them lies in the voltage-disturbances which they set up rather than in the relation of average load to the maximum load that the generating and transmission equipment will carry. These voltage-disturbances are often severe and it is usually sought to restrict them by provisions in the power-contract, sometimes by 'demand-charge' or other load-factor provision based upon a peak of short duration—one minute or less. This is not strictly a question of load-factor and does not come within the scope of this paper, as it cannot be controlled by scheduling operations, but only by some provision for storing energy such as a fly-wheel, storage-battery, or compressed-air storage. It is mentioned here because it is closely allied to the subject of the paper and the two are sometimes confused. In my opinion the matter of voltage-disturbance should be kept separate from load-factor; it may be guarded against by a simple provision in the contract prohibiting the use of any motor above a certain size without providing some means for absorbing the starting-currents. The matter of load-factor can then be satisfactorily treated on the basis of a 30-min. maximum-demand interval.

In a similar way, mention is made here of another load characteristic which is closely allied with the subject of this paper, namely, power-factor. The power-factor of mine-loads is usually good, for, although induction motors are used almost exclusively and many of them are lightly loaded, the bulk of the load will always be on large motors, well loaded. If all motors are of the induction type, and the transformer and feeder layout is properly designed, the power-factor will be about 85%. This can be increased readily by the use of synchronous motors, particularly for large air-compressors; in fact, air-compressors of the direct-connected type are often driven by synchronous motors even when no inducement is made in the power-contract. In most plants in the West, due to the fact that transmission lines are long as compared with the load to be carried, the line-charging current will offset the lagging current represented by a power-factor of 85%, but for the sake of those plants where a higher power-factor may be desirable, the fact is noted here that a moderate inducement in the rate would doubtless bring about an increase in the power-factor of mine-loads.

Power-Consumption of Various Operations. It is well to have in mind the nature of the chief power-consuming operations about the mine and mill and the relative consumption of each. For a typical case, these data are shown in the following table.

Operation	Percentage of total kw-hr.	Percentage of aggregate demand (Max. 30-min.)
Mining:		
Compressing air	13	19
Hoisting and tramming	4	7
Pumping	6	9
Milling:		
Crushing	2	4
Fine grinding	48	36
Concentrating	2	2
Cyaniding	21	17
General and miscellaneous	4	6
Total	100	100

This table is based upon operations at Goldfield, Nevada, from 1915 to 1918, but it is typical of gold and silver mining, and not very different from copper and other base-metal mining except that there would, of course, be no cyaniding. In some mines there is no water to pump, in others a great deal more. In a straight concentrating mill, where the only product is concentrate ready for shipment, the item for concentrating will be somewhat greater. In some oil-flotation plants the power will be around 8 or 10% of the total. In any case, the large item will always be fine grinding, that is, the opera-

*A paper presented at the meeting of the San Francisco section, American Institute of Electrical Engineers, September 23, 1921.

tion of reducing the ore from 1½- or 1-in. pieces to slime. Grinding, concentrating, and cyaniding are continuous operations and have a load-factor of nearly 100% except for variations in the supply of ore.

Crushing is sometimes continuous but more often a one- or two-shift operation and always makes a greatly fluctuating load. These fluctuations will not appear, however, in a 30-min. peak-demand. Crushing can be readily scheduled to suit the load; that is, it can be done at a time of day when the load from other sources is least heavy.

Mining proper cannot be scheduled to suit the load. It must be done to suit the men, for the simple reason that the payroll far outweighs the cost of power. For instance, a production of 1000 tons per day will require, say, 500 men receiving $2500 per day and will consume some 7500 kw-hr. costing $100. Mining is usually carried on in two shifts except where the work is to be rushed and the working space is limited, as, for instance, in shaft-sinking. It has an inherent maximum load-factor, therefore of 67%, and is usually about 50%. This covers air-compressing, hoisting, and tramming.

Pumping from mines may usually be scheduled to suit the power-contract, but this is sometimes prevented by lack of sump-capacity to hold the water between pumping periods.

Economics of Load-Scheduling. If no inducement is offered in the power-contract and no restriction made, the only load on the third or 'graveyard' shift will be that of the 24-hr. operations. Crushing and pumping will be done at the same time as mining, and since the shops, saw-mill, assay-plant, and other general and miscellaneous items will be day-loads and will outweigh the evening load for lighting, the peak will come in the day time, usually in the forenoon; moreover the peaks of the several loads will be simultaneous.

How far it will pay the company to go, in scheduling for the graveyard shift some of the normal day-load, will, of course, depend on the inducement offered in the power-contract. This may vary all the way from nothing, as on a straight meter-rate, up to that obtained on a flat-rate charge of, say, $10 per horse-power per month. Neither of these extremes will result in the maximum economy for both parties, and the modern method is a two-part rate, or a sliding-scale meter-rate depending upon 'hours use', or upon some other load-factor provision.

The two operations that can readily be scheduled are crushing and pumping. Crushing is a small item. Even when confined to one or two shifts, as is usual, the crusher-load for a 1000-ton mill is only about 80 kw., based on 30-min. maximum demand; and if the load-factor in the rate is equivalent to a demand-charge of say, $1 per kilowatt per month, the resultant saving by keeping this load off the peak will barely justify the hardship upon the crusher-men, arising from being required to work always on the graveyard shift. But if the demand-charge is, say, $4 per kilowatt per month, then the saving, $3840 per year, will justify additional investment for larger bins and a larger crusher, if that should be necessary in any particular plant.

Pumping from the mine, pumping water for use in the mill, and pumping fresh water for general purposes, may all be scheduled as desired provided there is sufficient storage-capacity. This is usually ample in regard to fresh water and water for mill use, so that no extra expense is involved; there is frequently no inconvenience to men, because the pumps are run without attendance. The problem of storage underground is more difficult. If the lift is great and the demand-charge rate also high, it will usually pay to create the necessary sump so that the pumping may be done entirely 'off-peak', even though this means the driving of long drifts for this purpose alone. Sometimes an old drift or stope is available as a sump and sometimes a reservoir can be bulkheaded in workings that are not in use. If necessary to create a sump, the cost will have to be figured against the saving that may be made. For instance, suppose the flow is 200 g.p.m., the lift is 1500 ft., and a demand-charge is $4 per kilowatt per month. This would require about 80 kw. for 20 hours per day. For this the demand charge would be $3840 per year. If pumping is to be confined to the graveyard shift, additional capacity of 12-hr. inflow, or 19,200 cu. ft., equivalent to a drift 8 by 8 by 300 ft. would be required, which would cost about the equivalent of one year's power saving, or $3840. Some additional pumping equipment will be required, also, but not much, for at least two pumps, one as a spare, are necessary for the 20-hour schedule, while for an 8-hour schedule it would be safe to operate both at once without providing a spare.

As regards the pump-men, no attendance is required for turbine-pumps and these, in fact, may be made automatic and 'remote-controlled' so that they can be started and stopped from the office on the surface. They can be thrown on at noon or at other times during the day whenever the load permits.

There is one other operation in which load-scheduling may be advantageous in some cases, namely, in fine-grinding in the mill. This is a 24-hour operation but the load can sometimes be lightened on day shift without loss of production, as when the mill is running ahead of the mine, or when the upper part of the mill is running ahead of the lower. This must be done with care as any interruption to the uniform flow through the mill may result in loss of extraction. The importance of this will be seen if it is remembered that, for instance, a 1000-ton mill on $15 ore is handling a gross value of $15,000 per day and, if the extraction is 90%, each 1% loss is $165 per day. For this reason, and because of the heavy investment in this equipment, it will not usually pay to install additional grinding equipment for the purpose of scheduling loads; but, where the conditions already exist, and the demand-charge is high, advantage may be taken of the opportunity. This was done at Goldfield with a saving of about $1000 per month, under a flat rate of $6 per horse-power per month.

Conclusion. Mine-loads can be scheduled so as to produce a very high load-factor; the extent to which such scheduling is economical depends upon local conditions and upon the inducement offered in the power-contract.

COPPER SHARES SHOW STRENGTH; REASON FOR OPTIMISM

Shares of the various copper-mining companies are in better demand at higher prices than for many months. While no one looks for a runaway advance, unless there should be a sudden demand on the part of domestic consumers to cover requirements for some time, tangible evidence points to a steady recovery in the industry. When copper stocks were depressed following the close of the War, estimates of huge amounts of metal all over the world were used to depress securities. At present just the opposite view prevails. While it is well-known that the available surplus is still in excess of normal requirements, the fact that current sales are twice as high as the monthly production has changed sentiment materially. The fact that most of the leading mines of the country are closed down, and further that it will be several months after resumption before copper comes on the market, adds strength to the market. The following table shows the 'low' for the year as compared with the recent 'high' and the advance:

	1921 low	Recent high	Advance
Ahmeek	40	54½	14½
American Smelting & Refining	29⅝	39½	9⅞
Anaconda	31¾	41⅜	9⅝
Calumet & Hecla	210	245	35
Chile	9	12⅜	3⅜
Chino	19½	26	6½
Copper Range	27	36½	9½
East Butte	7	10	3
Inspiration	29⅝	36½	6⅞
Isle Royale	16¼	20	3¾
Kennecott	16	22⅜	6⅜
Mohawk	43½	54	10½
North Butte	8	11½	3½
Old Dominion	15⅜	24	8⅝
Osceola	21	28½	7½
Quincy	33½	41	7½
Utah Copper	41⅛	52½	11⅜

JAPAN IS OUR BEST CUSTOMER FOR ZINC

If it were not for the small volume of pig- and slab-zinc moving out of this country to Japan since January 1920 the export trade in that metal would be small indeed. Japan was our best customer in August for the fifth consecutive month, exports to that country far exceeding those to any other.

In August 1,537,714 lb. of zinc in pigs, slabs, etc., was exported, and of that total 1,008,014 lb., or 65%, went to Japan. For the six months ended with August 1,905,748 lb. or 65% of our total export zinc trade during that period was with Japan. France and the United Kingdom were our best customers during the War and for several months thereafter. This year, however, not a pound has been exported to either of those two countries, whereas during the first eight months of 1920 France took 47,999,000 lb. and the United Kingdom 133,147,000 lb., so that it can be appreciated that the discontinuance of the export trade in that metal with those two countries has proved a blow to the producers of this country. Our export trade in pigs, slabs, etc., for the eight months ended with August amounted to 3,195,896 lb. against 198,738,000 lb. during the corresponding period of 1920, and 169,379,000 lb. during the first eight months of 1919. Our export trade in zinc sheets, strips, etc., for the eight months this year amounted to 2,320,000 lb., against 19,461,000 lb. during the same period last year, and 28,543,000 lb. during the first eight months of 1919.

The following shows how important a factor Japan has been in our zinc export trade during recent months, the figures being in pounds:

	Total exports	To Japan	Proportion of total, %
August	1,537,714	1,008,014	65
July	429,503	280,024	65
June	537,328	393,730	73
May	135,365	112,000	83
April	115,838	111,980	97
March	174,106	.....	..
Total	2,929,854	1,905,749	65

UTAH METAL OPERATORS INSTITUTE IS FORMED

A permanent organization to be known as the Utah Metal Operators Institute is the outcome of a highly successful series of meetings held at Salt Lake City last week. An annual conference will be a feature of the work of the Institute.

At the final session held on October 9 it was unanimously resolved that an executive committee should be created, this to consist of two representatives from the State's three leading districts, Bingham, Tintic, and Park City, to be selected by the delegates from these districts; two representatives from outlying districts to be approved W. Mont Ferry, chairman, and one representative each from the Utah chapter of the American Mining Congress, from the American Institute of Mining and Metallurgy, and from the State Industrial Commission. This committee, to be organized in the near future, will have for its chief function the drawing up of plans for the next annual institute.

Following are the programs for the meetings just held:

Friday, October 7, 9:30 o'clock—Keynote address, C. E. Allen, manager, U. S. Smelting, Refining & Mining Co., temporary chairman; address, Governor Mabey; paper, 'Requirements of Hoist-Signaling in Metal Mines', by Leonard Wilson; discussion led by T. P. Billings, O. N Friendly, and W. H. Cole; papers, 'Improved Methods of Stoping Adaptable to Utah Mines', by A. S. Winther, general superintendent, Utah Consolidated Mining Co., J. B. Hafner, foreman, Tintic Standard Mining Co., and A. P. Mayberry, superintendent, Centennial Eureka mine; discussion led by Joseph Hyland, R. E. Phelan, and J. A. Norden.

Friday, October 7, 2 o'clock—Paper, 'The Field for the Storage-Battery Locomotive in the Mines of this State', E. A. Hamilton, superintendent, U. S. Mines, Bingham; discussion led by L. R. Dobbs and H. T. Plumb; paper, 'The Efforts of the American Mining Congress in Standardizing

Mining Machinery and Methods', by H. C. Goodrich, chief enginer, Utah Copper Co.; discussion led by Charles Zabriskie and E. H. Burdick.

Saturday, October 8, 9:30 o'clock—Paper, 'Our Experience in Overcoming Hot Mine Gases', by A. J. May, superintendent, Tintic Standard mine; discussion led by Lew Merriman and A. C. Nebeker; paper, 'The Present Status of the Wet Stoping Drill', by H. G. Snyder, Metal Mine Inspector; discussion led by William Owens and H. N. Hartman; paper, 'Should Metal Mine Operators of Utah Conduct Future Meetings of this Kind?' by L. S. Cates, manager, Utah Copper Co.; discussion led by E. F. Birch, A. G. Mackenzie, D. D. Muir, and J. Fred Johnson.

UTAH-APEX V. UTAH CONSOLIDATED

The decision of the Federal District Court handed down in Salt Lake City last October, favoring the Utah-Apex Mining Co. in litigation with the Utah Consolidated Co., left the latter corporation under obligation to file an accounting of the ore declared by the court to have been unlawfully extracted from the Utah-Apex property. According to the Utah Consolidated accounting, the sum due Utah-Apex in accordance with the decision of the court amounted to about $650,000. Utah-Apex protested these figures and obtained an order of the court to permit the statement to be checked by an audit of Utah Consolidated books. The audit, it is claimed, revealed errors in the statements, and discrepancies between them and the books, which increased the amount due Utah-Apex to nearly $1,500,000. The accounting hearing began in the trail court on August 22. Utah Consolidated admitted errors and discrepancies in their accounting, but maintained different charges objected to by the Utah-Apex. Utah Consolidated again applied for an extension of time, and the hearing did not take place until September 29, when the court took the case under advisement. While these proceedings were pending, the appeal of the Utah Consolidated against the decision of the trial court was heard in Denver on September 6, the court taking the case under advisement for subsequent dicision.

SALES OF COPPER INCREASE

Sales of copper, both foreign and domestic, during September were approximately 100,000,000 lb. This is the largest monthly sale since last spring and compares with an average business of 75,000,000 lb. per month during July and August. Domestic sales showed more improvement than did foreign, most of the metal being sold during the last third of the month. Renewals of buying by brass interests helped greatly to increase the total.

Initial demand for 1922 copper has come to hand in an inquiry for 3,000,000 lb., to be delivered in installments of 1,000,000 lb. monthly during the first quarter. Producers thus far have refrained from opening their books for the coming year.

The Western Union Telegraph Co., which early this year bought a large quantity of copper, has re-entered the market for about 2,000,000 lb. Wire manufacturers have joined their inquiries with those of brass-mills, giving indication of a sharp improvement in demand from domestic consumers.

ACTIVITY OF THE A. S. & R. CO.

The Mexican operations of the American Smelting & Refining Co. are about the same as six months ago, as the rise in silver price has been too recent to have much influence as yet upon foreign ore-shipments. All the smelters of the company in Mexico, except the Asarco and the Monterrey plants, are in operation. The Pueblo plant is still shut-down as a result of the flood, while the Perth Amboy refinery has been shut-down for several months, the copper refining being now done at Tacoma for Western ores and at the Baltimore works for Eastern receipts.

In Colorado the Arkansas Valley plant at Leadville and the Durango lead smelters are both in fairly active operation, three furnaces are still running at the Garfield smelter, and the Tacoma plant is working about at capacity upon Alaska and South American ores. The Hayden smelter, which was operating mainly on Ray and Magma ores and the El Paso plant, which was treating principally Chino output, have been shut-down for several months. Three furnaces are in operation on lead-silver ores at Murray, as the Pittman Act has stimulated mining greatly in the territory served by that smelter. Also at the Murray plant four furnaces are busy on lead ores. The company's tin refinery at Perth Amboy is still operating, but the Bolivian mines have ceased shipping concentrate owing to discouraging prices prevailing on tin. The company is devoting its attention mainly to the problem of bringing down smelting costs. As yet no severe cuts in wages have been made.

ARIZONA

Jerome.—Calumet & Arizona has started the task of developing the Verde Central property. The work in an exploring drift already proves that the ore found several months ago continues for a considerable distance and is not a pocket as some thought at the time of the find. The property is situated close to that of the United Verde. Calumet & Arizona has appropriated a liberal amount of money for the thorough exploration of the claims of the Verde Central and is intent upon developing something of real value.

Miami.—On October 3 the Miami Copper Co. declared a dividend of 50c. per share, for the quarter-year ending September 30, payable November 15, to stockholders of record at the close of business on November 1.

CALIFORNIA

Auburn.—Charles Arch and Art. Sullivan are working on the Hard Climb mine in Duncan canyon, in an effort to find pay-gravel in three adits that have been driven on the property.——William Davis, who is prospecting the Home Ticket mine near Last Chance, has sunk an incline to the depth of 200 ft. and is now driving a raise in search of a channel which is believed to exist under the old workings of the mine.——Joseph Scherer and Davidson brothers are prospecting for pay-gravel on claims in the vicinity.

Dedrick.—All the machinery of a 30-stamp mill and the cyanide plant at the Globe mine has been dismantled and is being shipped to Gold Hill, Nevada, where it will be utilized in the plant being erected by the Comstock Mines Co. There will be 300 tons of machinery to ship by auto-truck from here to Redding and thence by rail to Gold Hill. The truck-freight is 2c. per pound. Much of this machinery was hauled from Redding to the Globe mine by freight-teams at a cost of 4c. per pound.

Downieville.—Excellent gravel is being mined at the Gold Gravel mine near the Sierra-Plumas line. The deposit was reached by a shaft sunk to a depth of 180 ft., following prospecting by drilling.——W. J. Nixon has found high-grade ore on his property on Bear Creek ridge.

Keswick.—The Mountain Copper Co. has completed 9 of the 30 towers for its tram from the Hornet mine to the new town of Matheson on the Southern Pacific railway. The cable, 5.2 miles long, has been received. The company is ballasting the side track at Matheson with slag from the smelter-dumps.

Lewiston.—Lawrence Gardella, of Oroville, is making rapid progress building the gold-dredge that is to operate at the Paulsen ranch. The boat will be launched about

October 15. The hull is 42 by 90 ft. and the buckets are to have a capacity of 7½ cu. yd. The work of the winter will be to install the machinery. The dredge will be in operation early next spring.

Randsburg.—California Silver Rand company reports for the week ending October 3, development work totaling 261 ft.; the main cross-cut on the 11th level was advanced 40 ft. Raise No. 1017 from the 10th level is now in shipping ore of good grade. A new raise is being started from the 10th level to follow the same streak as that being developed by raise No. 1017. South drift No. 913 is still following mill-ore, as is also drift No. 450. No. 2 shaft was not advanced during the past week, as lateral work on the first, second, and third levels prevented work in the bottom. The third-level station was completed, and the first- and second-level ore-pockets were holed through.

Mill construction is continuing steadily with a normal crew at work. Production of shipping ore was maintained at the customary rate of 440 tons for the week, all being sent to the Selby smelter.

The Randsburg Silver company advanced its faces 194 ft. during the 25 days ended October 3. Development along the vein 210 ft. east of the shaft is advancing to both the north and south, showing both shipping and milling ore. The work at present is confined to the 500-ft. level. The south-west cross-cut has cut a vein that is believed to be the same as that which the 9th level of the California Silver Rand is following.

Redding.—The option to purchase the Jacob Brothers hydraulic mine below Junction City has been extended by court order until October 1925. The option is held by W. H. Metson of San Francisco. The price is $21,005. The Jacob brothers, Henry and John, have been dead for several years. The administrator has not been able to trace the heirs in Germany.

COLORADO

Aspen.—An order has been placed by the Park Tunnel Tram Co. with the American Steel & Wire Co., of Trenton, New Jersey, for delivery within 30 days of all the necessary equipment for an aerial tram. Preliminary work on terminal site has commenced.

Breckenridge.—The Bethune group of mines, including the Mineral Point tunnel in the Beaver Dam district, has been sold to the Hockmarookus Mining Co., of Denver, headed by a woman who is prominent in mining and oil circles of the south-western fields. The property, including the Blind Tom and Baltimore mines, has produced rich silver-lead ore; settlement sheets show 60 to 90 oz. silver and 50 to 70% lead.

Cripple Creek.—September production totaled 39,404 tons with an average value of $9.24 and gross bullion value of $391,362. Shipments to the Golden Cycle mill for the month averaged 20 broad-gauge cars daily.——A 4-ft. vein of ore sampling 2 oz. gold has been opened by a lessee on the American Eagle.

The Mill of the Miami Copper Co., with the International Smelter in the Background

Hot Sulphur Springs.—A rich find of peacock copper is reported made on the property of the Electro Copper Co. in Eagle and Routt counties, on the line of the Denver & Salt Lake railroad. A tunnel has been driven 800 ft. into a blanket formation, the width of which is undetermined as yet. The average copper content is reported to be better than 4%. The high-grade sampled 37%. A mill has been erected and is being equipped, according to authoritative reports received here.

Salida.—The report of the purchase of the Ohio & Colorado smelter in this city, appearing in the 'Mining and Scientific Press' of August 13, was in error in so far as the name of the purchaser is concerned. Everly & Davis, of New York, are the new owners.

IDAHO

Ivers.—The Lost Packer mine has been bought by the Bingham Galena Mining Co., of Salt Lake City, according to reports. According to an engineer's report the mine has in sight $300,000 worth of ore ready for the mill and smelter. A vein 3 ft. wide, assaying $15, has been disclosed by a winze sunk from the tenth or 1000-ft. level. In an upper tunnel an orebody 5 ft. wide and 400 ft. long assays $10 per ton.

Soda Springs.—Four carloads of equipment for the Caribou Placer Mines Co. has been delivered here and will be transported to the mines 50 miles north-east. The company has purchased two motor-trucks for this purpose. A complete electric-power plant is included in the shipment. The camp will be completed by October 15. The buildings consist of a large mess-hall, storeroom, bunk-houses for the employees, tool-sheds, blacksmith shop, garages, and office building.

MICHIGAN

Houghton.—There was shipped out of the Lake district in September, 7,028,000 lb. of copper, as compared with 5,176,000 lb. for August. While shipments for August were the smallest for the season of navigation to date, the September shipments were the heaviest. This was due to large shipments during the latter part of the month. September shipments bring the total for the season so far up to 30,000,000 lb. Probably 10,000,000 lb. has been sent out by rail in that five-month period. September deliveries while the heaviest for the year were approximately only half of the average total for the corresponding month of normal years.

Although rumors are flying thick and fast in the district, there is no prospect of an immediate re-opening of the Calumet & Hecla mines. These mines still have a large surplus of metal and until it is nearly wiped out the time of resumption of operations will continue indefinite. All of the mines, however, are being kept in good physical condition. There has been little or no serious caving in any of the workings, which are closely watched and repairs made when necessary. Timbering is done when it is needed but this work to date has not been extensive. Some needed shaft-repairs have been made and all openings are kept free of water. Air-pumps are being used almost exclusively for this purpose although a bailer is employed in No. 5, Tamarack.

The Copper Range mines are still experiencing a considerable labor turnover in spite of the unemployment situation in the Lake district. Champion, Baltic, and Trimountain lost a total of approxmately 100 men in September, yet more than that number applied for and received work, the company finishing the month with a net gain of 50 in manpower. About 90% of the men taken on were Copper Country workers, the remainder coming from other districts, including some former residents who left to take jobs elsewhere and subsequently returned. Copper Range has been employing experienced men throughout the summer and has increased its payroll by several hundred since spring.

Copper Range has a comparatively small copper surplus, estimated to be not more than 5,000,000 lb. Its sales have been quite heavy of late, one order alone being for 1,000,000 lb. for a domestic consumer.

All openings in the Seneca mine continue in good ground. There is no diminution of values in any of the drifts, and this is particularly true of the 3rd level drift toward Gratiot, the longest opening in the property. The character of the rock in the new drifts from the 7th level is uniformly good and these openings are proving up the mine at depth. It is not yet known when a new hoist will be installed at No. 2 Gratiot shaft, which is to be sunk to a depth of 4000 ft. and connected with the Seneca shaft, but the shaft will be in readiness for immediate sinking as soon as the equipment is in position. It is being kept free of water by use of bailers.

MONTANA

Butte.—For the present at least, the East Butte Copper Co. will sell no more copper at 12¾c. per pound, according to authoritative reports. In line with its policy of disposing of only enough metal to keep liquid, the company has been selling at prevailing quotations and has done considerable business at 12½ to 12¾c. per pound. It has now instructed its selling-agent, however, to dispose of no more copper at 12¾c., believing that in the near future higher prices can be obtained. During the last two or three months, East Butte has refrained from publishing its production figures. It is estimated the company has been producing in the vicinity of 1,000,000 lb. of copper monthly, including the product treated for the Davis-Daly Copper Co. on a custom basis. Helped by dollar silver and a good grade of ore—averaging between 4% and 5% copper—East Butte has made a profit each month this year.

Troy.—A five-year lease on the property of the Consolidated Silver-Lead Mining Co., situated seven miles from Troy, has been taken by J. P. Schmuck and C. J. Cavenaugh, of Spokane, who are now driving an adit 300 ft. directly in the orebody.

NEVADA

Cortez.—The raise from the lower or Arctic tunnel of the Con. Cortez Silver Mines Co., driven to connect with the old Garrison tunnel, is progressing in the soft porphyry of the main dike. Some of this material is of milling grade, and ore was stoped in this dike above the upper tunnel.

Crow Springs.—Goldfield and Tonopah men have been rushing into the Crow Springs district, 28 miles north-west of Tonopah and on the Nye-Esmeralda county line. W. E. Edwards and J. A. Logan of Goldfield visited the district and from the 10-ft. shaft on the Betts lease on the claims of the Judson Mining & Milling Co. they obtained three samples as follows: No. 1, 18 in. on the hanging-wall side of the shaft, $910; No. 2, a check of No. 1, $1314; No. 3, 7 in. on the foot-wall side of the shaft, $1872. The ore contains 1 oz. gold to 1000 of silver. Edwards and Logan took a lease on a block 250 ft. from this shaft. The Hudson company was formed as the result of a compromise between Salt Lake and Tonopah men over their locations, which overlapped in places. The 17 claims owned by the company have been held for nearly 20 years by J. R. Walker and C. Walker of Salt Lake City. The development consists of five shafts, 50 to 300 ft. deep, and the 10-ft. shaft sunk recently by Betts. It is said that $50,000 worth of ore has been produced from these shafts, the average value being $50 to $100 per ton. Among those interested in the district are A. H. Jones of Salt Lake City and W. H. Royston, superintendent of the Belmont mill.

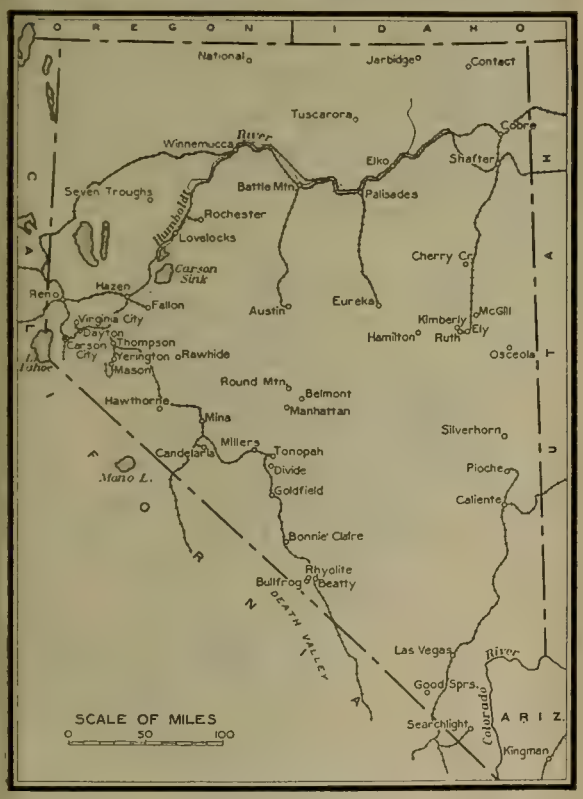
Divide.—The shaft of the Tonopah Divide has passed the 1100-ft. point. The shipment of $30 ore is being continued from the upper levels. The south-east drift on the 800-ft. level recently exposed seams of rich gold ore.

Goldfield.—More claims were located in Esmeralda county during July, August, and September than for many years past, according to Mrs. Rose G. Malone, county recorder. Most of the locations were in the Hornsilver district, with Argentite second, and Lone Mountain third. Argentite is reported to be developing into a district of more than usual importance.

Luning.—Rich silver-lead ore has been found in three distinct veins on what is known as the Wardner group of claims near Lucknow, nine miles north of Luning, near the Rawhide road. The former owner, who shipped some ore from this ground, permitted the claims to lapse and they were re-located by Luning men, who in turn failed to do the location work, and the claims were secured by Charles Ward of Sodaville and Joe Dietz of Luning. They shipped three tons assaying $334 per ton and netting $288 per ton.

F. E. Bass, of San Francisco, has an option on the claims and has paid $1000 down. The high-grade ore is 2 ft. wide.

Reno.—The mill of the Standard Metals Mining Co. in the Peavine district, 12 miles north of here, has been closed while the shaft is being sunk from 300 to 500 ft. Silver-galena ore was exposed in bodies of substantial size on the 200-ft. and 300-ft. levels. A. L. Chappell, the manager, has returned from Pittsburgh, Pennsylvania, where he obtained authority to enlarge the mill in case the ore is found at the 500-ft. level.——The main shaft of the Fravel-Paymaster Mining Co. is being sunk from the 200-ft. level. The property adjoins the Standard Metals mine and the collar of the shaft is 100 ft. higher than that of the Standard Metals Co. The same vein was opened on the 200-ft. level, exposing some good ore. A 75-hp. electric hoist has been installed for sinking. John Reinmiller, who opened



Map of Nevada

the Engels mine in Plumas county and the Mary mine at Silver Peak, Nevada, has been made superintendent.

Taylor.—The re-modeled plant of the Wyoming Mining & Milling Co. has been started; 40 to 50 tons of ore per day are being milled, coming principally from the old dumps. If the recovery in the mill is satisfactory the orebody will be mined.

Tonopah.—J. Hampton Williams, noted for his connection with the discovery and development of the California Rand mine at Randsburg, California, and January Jones, a promoter in the early days of Goldfield, have taken over 10 claims at Eden Creek, 50 miles east of Tonopah, and a company is to be organized by them for development of the group. The claims were sold by Mark H. Bradshaw, consulting engineer of Tonopah, who held an option. The ore is silver, in both sulphide and chloride form, and there is a small gold content. The principal work consists of two tunnels, one cutting the vein at 225 ft. The other tunnel, 500 ft. long, is 300 ft. from the vein at a depth of 600 ft. The vein, 5 to 15 ft. wide, outcrops for 1200 ft. A one-ton trial shipment of ore from a drift from the upper tunnel was made to the MacNamara mill here and the return was $98 in silver and $3 in gold. Ralph C. Nowland made an examination of the group for D. C. Jackling before it was taken over by Williams and Jones, but the owners wanted to retain an interest and Jackling would not consider a deal on this basis. The claims are in the Kawich range in the general vicinity of Bellehelen, Silver Bow, and Clifford.

Tule Canyon.—Silver Hills, Nevada, mines have been shut-down. The report of F. C. Merritt, engineer, estimates the gross value of the available ore at $25,000, and states that during the past 18 months the cost of mining exceeded the recovery from the ore. W. J. Loring, president, in a letter to the stockholders, says: "Failure of a mining property to realize expectations is, of course, unpleasant, but because one property has failed, there is no reason to assume that all chances of finding a property are lost. With the above information in your hands, as the latest that has been received by me, I submit it to you, and hope that your directors will be successful in finding a property that stands up under a rigid examination."

NEW MEXICO

Raton.—The Hercules Molybdenum Corporation, incorporated under the laws of Delaware, has filed its articles of incorporation with the State Corporation Commission of New Mexico and will maintain an office here. L. S. Wilson is resident agent. The company is authorized to engage in mining and milling. Its authorized stock is $1,000,000, of which $154,134 has been subscribed.

Silver City.—The Volcano Mines Co. has been incorporated under the laws of New Mexico with an authorized capital stock of $2,000,000. The incorporators and officers are: C. W. Mitchell, president and general manager; C. C. Royall, vice-president; Jackson Agee, treasurer; T. C. McSherry, secretary, all of Silver City. The Volcano group is situated near Steins, which recently was the scene of important discoveries. The mine, which has a record of more than $300,000 in silver, has been idle 20 years. Three hundred tons of ore shipped from the mine recently show an average value of $40 per ton.

UTAH

Alta.—About 100 tons of ore, valued at $7000, has been extracted from the new stopes near the top of No. 3 raise at the Alta Tunnel mine and shipped to the Murray smelter.

American Fork.—A bunk-house and several smaller buildings are being erected at the Pittsburg mine. By the middle of November the company expects to have a 6000-ft. tramway constructed that will have a capacity of 150 tons per 24 hours. As soon as the tramway is completed, mining machinery will be installed and development work undertaken from No. 2 tunnel, which gives a vertical depth on the vein of from 800 to 900 ft. In the early days of the camp, Frank L. Hines shipped 11,000 tons of ore from this property, averaging $1.50 in gold, 15 to 17 oz. in silver, and 48% lead. W. K. Yorston is in charge.

Bingham.—At a meeting of the stockholders of the Bingham-Galena Mining Co., on October 3, it was voted to increase the number of shares from 1,000,000 to 4,000,000, and decrease the par value of the stock from $1 to 25c. per share. The additional stock authorized will be placed in the treasury, to be used for the acquisition of the Lost Packer property in Custer county, Idaho, and any other properties that the board of directors may deem advisable to acquire.

Eureka.—The shaft-house at the Apex-Standard mine was destroyed by fire on October 1. The fire originated in the change-room. Only nominal damage was done to the com-

pressor, hoist, and other machinery. It is believed development work can be resumed within ten days.

Ore shipments for the week ending October 1 totaled 136 cars, as compared with 144 for the previous week. The Chief Consolidated shipped 38 cars; Tintic Standard, 35; Victoria, 10; Iron Blossom, 10; Iron King, 8; Dragon, 10; Eagle & Blue Bell, 8; Swansea, 5; Sunbeam, 4; Colorado, 2; Gemini, 2; Gold Chain, 1; Yankee, 1; Eureka Hill, 1; and Alaska, 1.

Operations continue satisfactory at the Zuma property. The sinking of the shaft will continue until the 1200-ft. level is reached, at which depth a tunnel will be driven. Ore is showing from the 500-ft. to the 875-ft. levels.

Moab.—The Blanding Irrigation Co. has acquired control of the Dream mine, one of the oldest in the Blue Mountain district. About $35,000 has been expended in developing the property. The new owners plan to drive a 1000-ft. tunnel to cross-cut the vein at a depth of 700 ft. It is reported that approximately 60,000 tons of ore is in sight. The mine is situated some distance from the main line of the Denver & Rio Grande railway, and, on this account, but very little ore has been shipped.

Park City.—Shipments of ore for the week ending October 1 totaled 1805 tons, as against 1436 tons for the preceding week. The Silver King Coalition shipped 827 tons; Judge allied companies, 586; Ontario, 410.

Between 30 and 40 tons of ore has been extracted from the orebody in a winze from the J. C. R. drift at the New Quincy property. While grab-samples show as high as 200 oz. silver per ton, the average for the lot is probably 100 ounces.

Salt Lake City.—During 1920, there was an average of 4965 men employed in the metal mines of Utah, 1534 in ore-dressing plants, and 2315 in smelters, making a total of 8814 employees. During 1919, there was an average of 8522 men employed in the metal-mining industry of the State; 13,901 in 1918; and 16,505 in 1917.

WASHINGTON

Keller.—The Addison Copper Co., owner of a property 3½ miles north of here, has resumed operations, according to C. A. Gray, manager. The Federal shaft, down 37 ft., will be extended 200 ft. The ore in the bottom of the shaft is worth $76 per ton, of which $15 is in silver; the vein is 4½ ft. wide between well-defined walls. It is proposed to drive the Mammoth tunnel to a point under the Bunker Hill shaft, 110 ft. distant. The vein is 6 ft. wide in the bottom of the shaft and assays 21% copper, 5% lead, and 52 oz. silver per ton. The mine is equipped with a compressor, and with the installation of another hoist the property will be developed to a depth of 600 feet.

WISCONSIN

Cuba City.—Shipments of water-white high-grade sulphuric acid are made at the rate of about 200 tons per week.

Higher prices for lead ore have stimulated lead mining. Three new producers are being developed and equipped in this district. One on the Kluck farm. Another is known as the New Lead Co. The third is on the Pascoe farm. Pumping machinery is being installed.

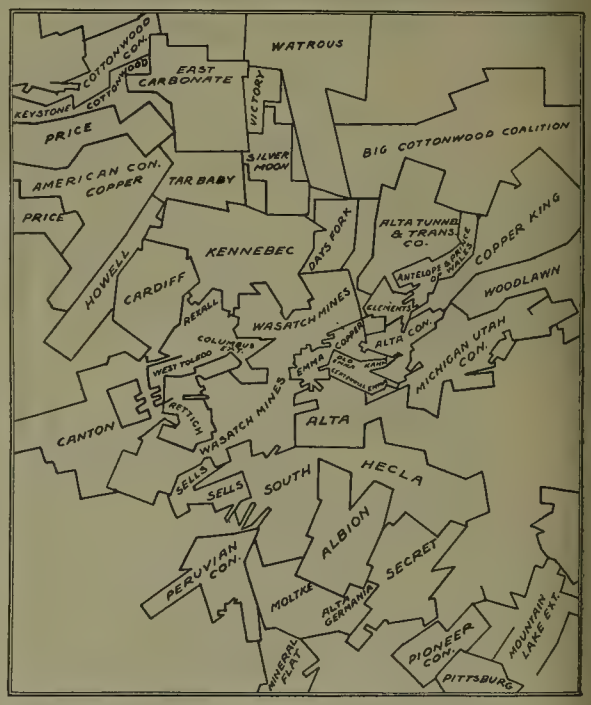
Day Siding.—The North Unity mine continues production of zinc ore, shipping in small lots weekly to the National Separators. Sales of lead ore were made the first week in October amounting to 100 tons.

Galena.—The Galena Iron Works Co., operating a foundry and mining-machinery repair-shop, resumed operations recently and is again finding sufficient demand for its supplies and service to operate steadily. This is regarded as a fair indication that mining will revive soon.

Livingston.—The Vinegar Hill Zinc Co. continues shipping zinc concentrate from the Yewdall mine, 300 tons per week being sent to the National Separators at Cuba City, there to be converted into sulphuric acid and high-grade magnetic-separator blende.

Platteville.—There has been no change in the zinc-mining industry in this district. Production of zinc concentrate is confined to mines outputting to provide base for acid manufacture. The lead-ore outlook has brightened immensely. The price of ore has advanced to $60 base, 80% metal content, and on this basis sales have been made bringing a top price of $62.50 per ton. Buyers and sellers alike are optimistic regarding the maintenance of these higher figures, which have stimulated more activity at mines, especially where indications point to a fair recovery. The volume of shipments is increasing and a fair portion of the reserve held in the field, estimated at about 3000 tons, will be sold.

The Block-House Mining Co., regardless of the depression, is constructing a new 150-ton zinc-mill on the Goke farm,



Claim Map of the Alta District in Utah

east of the Schroeder mine and mill, also owned by this corporation. The new structure is enclosed. Head-frame and shaft-hause are being built.

The Zinc Roofing & Products Co. has closed contracts with the Elkhorn high-school for a zinc roof; with the State government for a batten sheet-zinc roof for the heating-plant of the university; and with the Platteville State Normal School for a corrugated-zinc roof for Machinery hall.

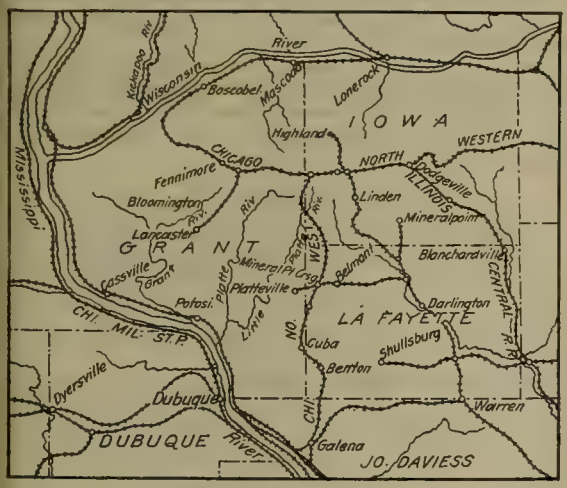
Shullsburg.—The Rodhams Mining Co., idle since early last spring, has resumed operations. A new vein is being opened and the new mine-site equipped. Sales of lead ore the first week in October amounted to 150 tons, consigned to the Federal Lead Co.

BRITISH COLUMBIA

Ainsworth.—W. E. Zwicky and R. Foulkes have leased the Krao mine and have moved a compressor from the Cork-Province to the property.——George McPherson and Jack Sherman have leased the Silver Hoard mine.——The Federal government is enlarging the wharf to facilitate ore shipping.

Alice Arm.—The Taylor Mining Co. has re-opened the Dolly Varden mine, and will put the railway in operation as soon as new cars, which have been ordered, arrive. Work will be principally directed toward development, with a view to putting the mine in good producing condition for next season; it is expected, however, that about 4000 tons of ore will be shipped before winter snows prevent further operation of the railway. About 30 men are employed, and, when the railway is closed, half of these will be moved to the Wolf mine, and development at both mines will be continued through the winter. One of the compressors at the Dolly Varden is to be moved to the Wolf, and the hydro-electric plant, which was completed last year, will provide power for all machinery at both mines.——It has been found impossible to complete the road to the Homestake mine before winter sets in; accordingly work will be suspended until spring.

Nanaimo.—F. H. Fraser and E. W. Lewis, representing the Vancouver Magnetite Steel Smelting Co., have been in the city endeavoring to obtain concessions with a view to erecting a 50-ton electric smelter for the manufacture of pig-iron and steel. The company proposes to develop its own power from the Nanaimo river, and to erect furnaces similar to those now in use in Norway and Sweden. The company claims to have spent $67,000 in experimental work and to



The Mining Districts of Wisconsin

have produced high-grade steel from the British Columbia magnetite ores. It further claims that it is backed by British capitalists that are prepared to put $5,000,000 into the enterprise, provided satisfactory terms can be made with the city.

Vancouver.—The Roses Gulch Placer Gold, Ltd., has been organized in this city, with a capital of $100,000 in $10 shares, to operate a group of placer claims near the Bullion mine on the Quesnel river.——According to the Dominion Bureau of Statistics, the output of lead for the first half of the present year is 90%, and the output of zinc 70%, of the total for the whole of last year.——The Rock Creek Mining Syndicate has been organized in this city to operate a placer-gold deposit at the mouth of Rock creek, a tributary of the Kettle river.

MEXICO

Durango.—Antonio Soto, representing Manuel Juarez, has made application for titles to a group of four claims to be known as Natalia No. 2, situated in the Plomoso mountains of the Guanacevi mining district. The new location lies in the vicinity of the Primavera, La Aventurera, La Cumbre, and the Torreon mines which produce gold-silver ore.

Miguel Chavez of the Santiago Papasquiaro district has re-located the old Santa Eduwigis and El Tejon mines on the south-east side of the Alejandra range of mountains in the municipality of Otaez. The two properties are to be re-titled under one name, El Tejon.

Luis J. Peach is interested in some new properties in the Otaez mining district which he is preparing to develop.——Gerald E. Norton has made application for another group of five claims in the Pueblo Nuevo district which are to be titled under the name of El Bello Encanto. They are situated west of the Javali mine.——Albert Niebla, of Topia, has taken over the San Jose mines in the municipality of Tamazula. A shaft is to be sunk on the main vein, and lateral development work will follow.

Zacatecas.—A number of local mining men of Chalchihuites have taken over the Auxiliadora group of silver-lead mines in the San Jose mountains at San Juan, which is situated about two miles from Chalchihuites. The properties are to be worked by Susano Banuelos, Benjamin Rodriguez, Agustin Ramirez, and others.

A large group of mines, comprising about 28 claims in all, has been located by Ubaldo Fernandez in the Chacuaco mining district near San Alto. The survey will include the old San Eliseo silver-lead mine which has been abandoned for a number of years and was recently declared forfeited by the secretary of industry and commerce.

John Emerson, Charles E. Snyder, and George Davis are developing a number of properties in the Sombrerete district.——It is rumored that San Antonio capitalists will shortly begin the erection of a concentrating plant at Chalchihuites for handling the ores from the mines and some of the old dumps which contain good ore.

ONTARIO

Cobalt.—Rain has become general throughout Northern Ontario, and the mine operators feel assured of all the hydro-electric power required to maintain operations at full capacity during the winter.

Silver is being produced by the La Rose Consolidated from four properties, these being the original La Rose, Princess, University, and Violet. The recently discovered vein at the 570-ft. level of the Violet contains silver across a width of six feet. From all four properties an average of 120 tons of ore is being drawn daily. Production is at the rate of over 40,000 oz. silver per month and the output for the current year will be the highest since 1917.——During the fiscal year ended August 31, the Kerr Lake Mining Co. realized $478,979 net profit. This came largely from the company's operations in Utah, and compared with net profits of $916,089 during the previous year.

The Nipissing has started a third diamond-drill hole on the Rochester property, which it holds under option in the Porcupine district.——A small mining plant is being installed by the Premo-Sliver-Cobalt Mining Co. on property situated near Latchford.

Kirkland Lake.—At the King Kirkland the work of surface exploration has almost been completed with the result that 32 veins have been exposed, enabling the management to select the most suitable location for a central shaft. A large compressor will be installed and development work carried to deep levels.

The Comfort-Kirkland has an electrically-driven plant in operation and is sinking a shaft. Good results are reported. The orebodies of the Ontario Kirkland run in the direction of the Comfort.

The Granby-Kirkland has uncovered and is opening up its 14th vein which is 5½ ft. in width. Channel samples show high gold content and the wall-rock is well mineralized.

Larder Lake.—The Crown Reserve which is conducting exploration work on a wide mineralized body has found a good body of ore which yields $6 per ton in gold.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. W. Purington is on a visit to Washington.

Bulkeley Wells was at Grass Valley this week.

Charles W. Teets has moved from Denver to Torrington, Wyoming.

Whitman Symmes has returned to San Francisco from New York.

Roy E. Cohn has returned from Chile to San Francisco for a short visit.

J. R. Kingham has moved from Victoria, B. C., to Boston, Massachusetts.

A. W. K. Billings has returned to New York City from Barcelona, Spain.

Harry R. Bischoff has moved from St. Paul, Minnesota, to Wallace, Idaho.

Glenn L. Allen, of Warren, Arizona, is at Guadalupe, Zacatecas, Mexico.

J. C. Kennedy has moved from Yerrington, Nevada, to Sacramento, California.

Etheredge Walker has moved from Trinity Center, California, to Boise, Idaho.

J. N. McLeod has moved from Carmangay, Alberta, Canada, to Dividend, Utah.

Corey C. Brayton is on a trip through British Columbia, Idaho, Montana, and Utah.

R. C. Gemmell has returned to Salt Lake City after a short vacation in southern California.

A. Doyle, formerly with the El Oro Mining & Railway Co., in Mexico, is at Richmond, Virginia.

G. Howard Birch, president of the Dan Creek Mining Co., at Dan Creek, Alaska, is in New York.

Joseph Errington was recently at Toronto for the annual meeting of the McIntyre-Porcupine company.

William Wraith, general manager for the International Smelting Co., has returned to New York from the West.

Charles W. Stimpson, of Salt Lake City, passed through San Francisco on his way to Honolulu, on a brief holiday.

E. J. Raddatz, president of the Tintic Standard Mining Co., has returned to Salt Lake City after a visit to Los Angeles.

Arthur L. Walker, Professor of Metallurgy in Columbia University, has returned to New York from a holiday in France and England.

H. L. Payne, of the firm of Baverstock & Payne, of Los Angeles, was engaged this week as expert chemist in legal controversies in Arizona.

Dwight C. Bardwell is now assistant physical chemist at the Rare and Precious Metals Station of the U. S. Bureau of Mines, at Reno, Nevada.

R. G. Hall, resident manager for the Burma Corporation, at Namtu, Northern Shan States, Burma, expects to return to the United States shortly.

J. J. Gorrell has resigned from a position in the technical direction bureau of the Aluminum Company of America to become chemist with the Cambria Steel Company.

H. W. Thomson will represent the 'Canadian Mining Journal' at the American Mining Congress convention and exposition to be held at Chicago from October 17 to 22.

C. W. Botkin, recently research engineer at the Colorado School of Mines, is now the head of the Department of Chemistry, New Mexico College of Agriculture and Mechanic Arts.

Martin Schwerin has completed three years of management of the Spar Mountain Mining Co., at Cave in Rock, Illinois, and will resume the practice of consulting mining engineer after January 1, with offices at 42 Broadway, New York.

Walter Fitch, president, and **Cecil Fitch**, general manager, for the Chief Consolidated Mining Co., have returned to Eureka, Utah, from a holiday at Coronado Beach, California.

J. O. Elton, recently assistant manager of the Great Falls smelter of the Anaconda Copper Mining Co., is assistant general manager for the International Smelting Co., succeeding **O. M. Kuchs**.

M. H. Roberts, **R. C. Tolman**, and **W. L. DeBaufre** are to constitute a board of engineers, appointed by the Director of the U. S. Bureau of Mines, to study the production of helium at Petrolia, Texas.

H. L. Brown, who has been with the American Metal Company for several years, has just been appointed consulting mining engineer to the Compañia Minera de Peñoles, which is one of the subsidiaries of the American Metal Company.

O. M. Kuchs, who has been assistant general manager in Utah for the International Smelting Co., has become general manager for the Andes Copper Mining Co., with headquarters at Potrerillos, Chile. He sails from New York on October 26.

Bernard MacDonald, previously in charge of the mining and milling operations of the Veta Grande unit of the American Smelters Securities Co. in the Parral district of Mexico, has opened an office in the city of Parral, and will resume consulting practice.

Walter J. Eaton has resigned as superintendent of the Naica and Santa Eulalia units of the American Metal Co., at Durango, Coahuila, Zacatecas, and Chihuahua, Mexico, to become mine superintendent for the Smuggler-Union Mining Co., at Telluride, Colorado.

OBITUARY

S. S. Voorhees, for eleven years on the staff of the U. S. Bureau of Standards, died at Portland, Maine, on September 23, aged 54. He was educated at the Lehigh and George Washington universities; prior to joining the Bureau he was in the research department of the Pennsylvania, Southern, and New York Central railroads.

Charles Walter Whitley, vice-president of the American Smelting & Refining Co., in charge of the company's plants in the United States, died of pneumonia on October 9 at St. Luke's hospital in New York. He returned a short time ago from a four weeks trip to Mexico. He was born in Chicago on June 20, 1869. Completing his elementary-school education in that city, he entered the Massachusetts Institute of Technology in 1887, graduating in 1891. He entered the street-railway business, shortly after his graduation, in the capacity of electrical engineer for the Chicago City Railway Co. Subsequently he assumed the management and control of the Canyon ferry dam on the Missouri river, 22 miles from Helena, Montana, and while in that State became identified with the mining and smelting business. He was manager of the United Smelting & Refining Co.'s plants at East Helena and Great Falls, later becoming general manager for the American Smelting & Refining Co., with headquarters at Salt Lake City. Subsequently he became vice-president of that company, making his office in New York after having been placed in charge of all the smelting and refining plants in the United States. He married Dorothy Kinney, of Rock Springs, Wyoming. Four children were born to them, two daughters and two sons. Although his personal attention was given to the smelting company of which he was vice-president, he was interested in many large corporations, being a director of the American Smelting & Refining Co. and of the American Smelters' Securities Co., president of the Utah Steel Corporation, and director of several banking companies in Utah. He leaves a host of friends who will mourn deeply his untimely death.

THE METAL MARKET

METAL PRICES

San Francisco, October 11

Aluminum-dust, cents per pound	65
Aluminum, sheet, cents per pound	58
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.25
Lead, pig, cents per pound	4.95—5.05
Platinum, pure, per ounce	$80
Platinum, 10% iridium, per ounce	$98
Zinc, slab, cents per pound	6.25
Zinc-dust, cents per pound	9.25

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Oct. 4	70.62	42.50	Aug. 29	62.10	38.10
" 5	70.37	42.12	Sept. 5	62.50	38.10
" 6	69.37	41.25	" 12	63.96	38.98
" 7	70.37	41.87	" 19	65.14	39.56
" 8	71.37	42.37	" 26	67.68	40.96
" 9 Sunday			Oct. 3	71.07	42.89
" 10	72.25	42.25	" 10	10.73	42.06

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Oct. 4	12.37	Aug. 29	11.58
" 5	12.50	Sept. 5	11.72
" 6	12.62	" 12	11.94
" 7	12.75	" 19	12.08
" 8	12.75	" 26	12.12
" 9 Sunday		Oct. 3	12.21
" 10	12.82	" 10	12.64

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Oct. 4	4.70	Aug. 29	4.40
" 5	4.70	Sept. 5	4.44
" 6	4.70	" 12	4.55
" 7	4.70	" 19	4.60
" 8	4.70	" 26	4.68
" 9 Sunday		Oct. 3	4.70
" 10	4.70	" 10	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Oct. 4	5.05	Aug. 29	4.65
" 5	5.05	Sept. 5	4.67
" 6	5.07	" 12	4.70
" 7	5.07	" 19	4.70
" 8	5.10	" 26	4.73
" 9 Sunday		Oct. 3	4.94
" 10	5.10	" 10	4.74

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.09
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.60	6.03	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.70	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Sept. 13	47.50	Sept. 27	47.50
" 20	47.50	Oct. 4	47.50
		" 11	47.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	86.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

REPORT OF CHAMBER OF COMMERCE OF THE UNITED STATES ON EUROPEAN AFFAIRS

A report has been published from a special committee from the Chamber of Commerce of the United States, the clearing house of the chambers of commerce of the country, that went to Europe to study conditions there at first hand. Not a name on that committee is known in politics. Every name on it, however, is known in the world of business. Query: Are business men fit to deal with such a question? We think they are better qualified than politicians with axes to grind. The reporters, we should judge from their report, looked at things from the economic point of view as it bore upon the United States; and that is what they went to Europe for, not in the interest of the latter but of their own country, says the 'Rocky Mountain News'.

One finding from that report involves the whole question of depression as it affects this country along with others less fortunately situated: "The consumption of three hundred million people is reduced to 30% of normal. The world is operating on a basis of less than one-half of the pre-war standard."

What is going to be done about it? This committee, composed of men of large affairs, has no panacea that would restore the world to its equilibrium overnight after seven years of debauch. But it does point out that unless the United States comes forward as a stabilizer Europe will go from bad to worse. That continent is dancing on the top of a volcano. The committee is convinced that the United States cannot refrain from active participation in the settlement of Europe's economic, financial, and political situation without loss to itself. If Europe cracks, something will happen over here.

"In every country visited the opinion was expressed that neither western nor central Europe can be restored to a condition which promises hope and progress for the future without our assistance," the report states. "Every country desires our friendship and assistance, and it is apparent we can participate in the restoration of commercial and industrial productivity on any reasonable and consistent terms, either by modification of the Versailles treaty to meet the policies of the United States, or independently of it."

Without attempting to speak for political Washington, we believe that what the committee suggests will be the ultimate conclusion formed at the capital, that the government of the United States shall take a hand on its own terms in preventing a second debacle and rescuing the continent from its own follies; and this will be done not as an altruism but as a matter of sound foresighted policy.

Germany is the weakest portion of the volcano's rim. Its present government is seeking earnestly to carry out its agreements and make restitution, but opposed to it is the militaristic-monarchical party, still powerful, that demands repudiation and defiance. If the present government fails, France will step in and take possession of what it requires, as a guarantee for its war losses, in the industrial parts of Germany, and this will lead to a complete break and discord among the allies, with war threatening on every front. And there is but one nation that can enforce peace without the necessity of an army.

MONEY AND EXCHANGE

Foreign quotations on October 11 are as follows:

Sterling, dollars:	Cable	3.86½
	Demand	3.87
Franc, cents:	Cable	7.37
	Demand	7.39
Lira, cents:	Demand	4.05
Mark, cents		0.86

Eastern Metal Market

New York, October 5.

Strength characterizes all the markets; further advances in most are noted.

Demand for copper is improving and prices are a little higher.

The tin market is moderately active and if anything firmer.

Demand for lead is good with prices firmer at last week's levels.

The zinc market is more active and higher.

Antimony is considerably stronger.

IRON AND STEEL

For the second time since the low dip in July, pig-iron production is an index of definite improvement in the steel industry. The pig-iron total for September was 985,529 tons for 30 days, 32,850 tons per day, as compared with 954,193 tons in the 31 days of August, or a daily rate of 30,780 tons, according to the blast-furnace returns of 'The Iron Age'. Fourteen blast-furnaces were blown-in during September and two went out, making a net gain of 12. The daily capacity of the 82 furnaces active on October 1 is estimated at 35,650 tons, as against 30,770 tons for the 70 furnaces in blast one month previous. The Steel Corporation blew in six furnaces last month, in view of the increased steel production required by recent large orders in sheets and wire products. A further pig-iron gain is indicated for October, seven blast-furnaces being scheduled to blow-in during the first half of the month.

Structural-steel lettings of the week, covering sizable projects, aggregate fully 18,000 tons, with an 8000-ton structure for a Masonic temple at Detroit the conspicuous item, and fresh proposals total about half the amount, including 3000 tons for a new roadway for the Manhattan bridge in New York.

COPPER

It is confidently asserted that September sales of copper totaled 100,000,000 lb. and it is generally stated that there are inquiries in the market for 15,000,000 to 20,000,000 lb. more, including an inquiry for 10,000,000 lb. from the American Brass Co., which bought 5,000,000 lb. a week ago. In fact some consumers who thought they could buy under 12c. a few weeks ago are finding it difficult if not impossible to buy under 12.25c., delivered, if at that. Prices have advanced until electrolytic copper for early delivery (October) is quoted today at 12.37½c., New York, or 12.62½c., delivered, with the market strong and more cheerful than in many weeks. Forward positions by months are ⅛ to ¼c. higher.

TIN

This market is moderately active and steady. There continue to be fair sales of Straits tin both prompt and future; at least 20 tons was sold last Friday, September 30. Both consumers and dealers were participants. Prices continue to hover around 27c., New York, for spot Straits with the closing price yesterday at 26.75c., the same as a week ago. Statistics for September show that deliveries into consumption were 260 tons, of which 2500 tons came in at Atlantic ports, with 1756 tons in stocks and landing on September 30. Imports for the first nine months of 1921 have been 1580 tons against 35,900 tons for the same nine months in 1920. American pure tin is quoted at the same price as Straits tin or 26.75c. for prompt shipment.

LEAD

This market is not quite so active as it has been, but it continues strong with demand moderate and steady. The leading interest continues to quote 4.70c., New York and St. Louis, while independent sellers accept business at 4.50c., St. Louis, but ask from 4.70 to 4.75c., New York, or a slight advance over the major interest.

ZINC

Prices have continued to advance until prime Western is now quoted at 5.05c., St. Louis, or 5.55c., New York, which is 20 points above the levels prevailing a week ago. This is due to two causes besides the increased demand from some consumers. Producers have sold a large part of their output for October this early in the month and are not selling their stocks produced at higher prices. The principal demand is reported as coming from galvanizers.

ANTIMONY

Demand is moderate but the market is firm at 5c., duty paid, for wholesale lots for early or October delivery.

ALUMINUM

Virgin metal in wholesale lots for early delivery is quoted at 24.50c. f.o.b. plant, with the imported metal of the same grade available at 18 to 19c., New York, duty paid.

ORES

Tungsten: There is no change in conditions and there is no demand with quotations nominal at $3 per unit upward, depending on grade and quantity.

Ferro-tungsten: Quotations for the domestic alloy remain nominally unchanged at 40 to 45c. per pound of contained tungsten. The foreign alloy is quoted at 50c. per pound of contained alloy.

Molybdenum: There is no change with quotations nominal at 50c. per pound of MoS_2 in regular concentrates.

Manganese: There is absolutely no interest with stocks large as well as imports. Quotations are nominal at 20c. per unit, seaboard.

Manganese-Iron Alloys: German ferro-manganese is reported offered at about $53, seaboard, and sales are heard of but not confirmed. American and British alloys are unchanged at a basis of $58.35, seaboard. Spiegeleisen is quoted at $25 to $26, furnace. There is but little demand for either alloy.

PRICES FOR CRUDE-OIL

The estimated average value of crude-oil produced in the United States in August was $1.07 per barrel as compared with an average for the first eight months of $1.67 per barrel and high in 1920 of $3.07. August represents the bottom price levels, if advances of 25 to 50c. per barrel which have taken place within the last month are held. The August average is the lowest at which crude-oil has sold since 1915, when it was 64c. per barrel. In 1916 the average was $1.10, and it mounted steadily in the years following until the peak of $3.07 was reached in 1920. Gradual recessions occurred during the first eight months of 1921, the total decline compared with the peak of 1920 being 65%. The average of $1.07 per barrel compares with $1.10 in 1916. Consumption of oil has increased largely since that year because of the increase in the number of motor vehicles in the United States. In 1920 there were 9,211,000 cars, compared with 3,512,996 in 1916 and 2,445,000 in 1915, a gain of 6,766,000 cars since 1915. Another factor causing greatly increased consumption of oil is the use of fuel-oil in ships, industrial plants, and railroads. Consumption of fuel-oil alone in 1920 amounted to approximately 208,000,000 bbl., accounting for 40% of the quantity of all products consumed that year.

Mining and Scientific Press

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T. A. RICKARD, ... Editor

WE have received a postcard from the Secretary of the Institute warning us that the forthcoming issue of the Institute magazine will contain sundry articles by gentlemen of considerable prominence. Was this done to arrest a customary motion toward the waste-basket, or for the purpose of spending a little money?

PROSPECTING needs all the extraneous help that can be given to it; sometimes the unexpected and the bizarre may prove of importance. Mr. Frank D. Pagliuchi, while making an examination of a prospect in Venezuela, frequently heard the sharp cry of a bird, gray in color, and about the size of a robin. It is called locally *el minero* (the miner), and its presence is always taken as an indication of the proximity of quartz. Mr. Pagliuchi was advised that, if he wished to find gold, he should look for a *mora* tree. Seeing one of them near the vein he was examining, he continued his researches, to find that the tree evidently thrived in silicious ground, and bore berries that were eaten by the bird. Thus it is that whenever such a cry is heard, quartz may be found in the vicinity; it may or may not be auriferous, but the prospector is helped if he be shown where to look for it.

ON another page we print an article on 'Shop-Operations and Repairs on Gold-Dredges', by Mr. Frank A. Stanley, editor of the 'Western Machinery World', a monthly periodical published in San Francisco. Mr. Stanley's viewpoint, primarily, is that of the mechanic; he discusses sundry features of the repair work done by the Natomas Company of California in its shops at Natoma, the base of operations for seven or eight large dredges that the company is now operating. When a placer is once tested and a decision is reached as to its suitability for dredging, the problems of the engineer are principally mechanical. His task is to move gravel economically. The most important item in the cost of dredge-operation, aside from interest on the invested capital, is the maintenance of the machine, which inevitably is subjected to the most severe strains. Accordingly, the superintendent's efforts are devoted largely to obtaining the most durable materials for the working parts, and to prolonging the life of them by devising economical methods of repair. Mr. Stanley has touched only the high-lights of a few important operations. For instance, his mention of the heat-treatment of bucket-pins forged of chrome-vanadium steel introduces a topic about which pages might be written. The use of the oxy-acetylene torch for welding is an operation that dredge engineers have developed to a high degree of efficiency, but that still affords opportunity for improvement. The excellent illustrations that accompany Mr. Stanley's article show a number of uses of the oxy-acetylene torch. We offer our columns to others who are interested in exchanging views on these subjects.

IN our issue of July 9 we offered some gratuitous advice to the officials of the Bingham-Galena Mining Company, who, in face of strong opposition on the part of reputable mining people at Salt Lake City, persisted in allying themselves with Jacob S. Herzig, *alias* George Graham Rice, in the promotion of their enterprise. Mr. E. C. Bellows, Commissioner of Corporations for the State of California, refused to allow stock of the Bingham-Galena company to be sold in this State; his action evoked sundry caustic protests from Child, Barclay & Company, a firm of brokers at Salt Lake City, who had circularized some of Rice's former victims in California with the bait that an investment in Bingham-Galena would recoup their losses in the notorious Broken Hill fiasco. The Utah State Securities Commission at that time took the stand that the conduct of the company's affairs afforded no ground for a refusal to permit the stock to be marketed in Utah, but apparently its peculiarly friendly attitude has changed. It seems that the Bingham-Galena officials have been cited to appear before the Commission to explain sundry transactions; coincidentally, the stock has taken a tumble on the Salt Lake Exchange to 6 cents from a high point of 38 cents. Meanwhile Rice and his one-time brokers are "engaged in mutual recriminations and accusations of bad faith and worse", according to the 'Salt Lake Tribune'. Mr. Allen T. Sanford, a reputable attorney of Salt Lake City, prominently identified with the Bingham-Galena company, has succeeded in obtaining the acceptance of his resignation, which he submitted some weeks ago. Rice is the kind of man who, on account of some peculiar kink in his moral fibre, has an abhorrence of honest dealing. We trust that Child, Barclay & Company, Mr. Sanford, the members of Utah's Securities Commission, and the ignorant victims who lost their

money gambling in the stock, all have learned a lesson; and we hope that legitimate mining in Utah has not suffered too seriously from the fiasco.

NOMINATIONS for the presidency of the Institute are in order. We understand that Mr. Edwin Ludlow is unable to accept re-election, therefore the choice of a successor must be made by the committee appointed for that purpose. The chairman of the committee is Mr. Arthur Thacher, of St. Louis, and it was hoped by many members that he might be prevailed upon to accept the nomination, but, we are informed, he has declined the honor. For that we are sorry, because Mr. Thacher in character and in reputation is of the requisite stature and would have made an excellent president. At one time there was talk of selecting a Western man; whereupon many of us on this side of the continent urged the nomination of our 'favorite son', Mr. Charles W. Merrill, but he also was compelled, by the exigencies of his own business, to decline. The search for suitable presidential timber appears to have turned on its tracks and is now resting in the East, where it has lit upon Mr. Arthur L. Dwight. If we are not to have a Western man for president, then by all means give us Mr. Dwight, whom Western men will be glad to accept as the titular chief of the mining profession in this country. A New Englander by birth, a graduate of the Columbia School of Mines, a metallurgist of the first rank, an officer in the Engineer Corps of the Army, a scholar and a gentleman, he has qualifications that all will acknowledge gladly. His record in the War was fine; he served with the 11th Engineers and retired with the rank of Lieutenant-Colonel. The British gave him the D. S. O.; General Pershing cited him for specially meritorious conduct. He knows the West; for 13 years he was at the Colorado smelter in Pueblo. We venture to speak for our readers in welcoming his nomination.

DISCUSSION this week opens with a letter from Mr. Henry F. May on the revision of the mining law. Mr. May is a lawyer, now resident in San Francisco but formerly in Denver, where he took part in many important litigations arising from disputed interpretations of the mining law, so that he knows well whereof he speaks. Among other points he refers to the sequestration of the public domain and the check to exploratory work that follows from the holding of claims without either exploration or development, and therefore he demurs to the postponement of work for discovery, by "the mere payment of comparatively small sums of money". The prospector thinks the sum is large; to him it may be so, but to the mine operator of large means there is given the opportunity to 'tie up' considerable areas at will, without doing the one thing that the law is supposed to stimulate, namely, the finding of ore and the production of the metals for industrial purposes. Mr. William Crocker appreciates both the good and the bad features of the proposed revision. He endeavors to expose the conditions to which the law would apply undesirably, and argues in behalf of the granting of ground sufficient in area to encourage large-scale operations. His text is "the economic unity of an orebody", but the suggestion he makes is, we believe, hopeless; for he asks for a classification of ore deposits and an application of the old and new laws respectively in accord with the classification. Mr. Robert J. Burgess contributes some interesting notes on the system of veins in the Big Bend district. Mr. G. W. Gilman describes the method of treating gold-silver ore at Hayden Hill, California. Mr. John T. Reid, of Lovelock, Nevada, an experienced mining engineer, makes a plea for help to the prospector. We give space to him although we find it impossible to endorse his idea, which is that the prospector should be compensated for his work on a claim, even if it prove unfruitful or otherwise unsuccessful, by being permitted by law to file a lien upon the ground, such lien to be met by any subsequently successful prospector or owner of the claim. In other words, Mr. Reid thinks it unjust that a worthy prospector should not be compensated for his hard, even if fruitless, labor on a claim that subsequently proves to be the basis of a profitable mine. The idea is generous, but it is wholly impracticable. Every day men are starting enterprises that will fail, but that serve as stepping-stones on which other men cross to affluence. We join with Mr. Reid in goodwill to the prospector, but we recognize that he—the prospector—is no more entitled to special consideration than others who start and fail. It is 'the rub of the green', as a golfer would say. Mr. Crocker has a second letter in this issue; it discusses Mr. Gerald H. Hutton's excellent article on the valuation of placer deposits. We shall leave it to Mr. Hutton to reply to Mr. Crocker. Mr. L. O. Howard, Dean of the School of Mines in the State College of Washington, contributes a friendly criticism of the cases cited by Mr. Morton Webber to illustrate the difficulties arising in the valuation of old mines. Mr. Webber will reply in due course. A note on the use of pulverized coal in smelting operations is contributed by Mr. R. E. H. Pomeroy, of the Bonnot company.

The Interrogatory

In this issue we end the publication of the replies sent to us in response to an interrogatory in regard to the present condition of the metal-mining industry. This interrogatory was intended primarily to help our advertising clients, but it yielded information that we felt sure would interest our readers as well, so it was reprinted serially in three consecutive issues, after having been sent to the advertisers in pamphlet form. The answers are interesting because they come from the right men; it would have been improper, without specific permission, to have published the replies over the signatures of the individuals, but we gave a list of those who answered, so that the reader might judge for himself as to the reliability of the source as a whole. It will be noted that the preponderance of opinion favors the belief that gold mining is expanding at the present time. One reply lays stress on the fact that the stagnation in base-metal mining is stimulating the search for gold and

the re-opening of idle or abandoned gold mines. The gradual reduction in the cost of labor and of supplies favors activity in this direction, says another. In regard to the McFadden bill, it is evident that not much help is expected from this proposed legislation. Opinions are divided; naturally, if any special legislation favoring gold mining is likely to be passed, it will be welcomed by those whom it will help, but many of them are honest enough to recognize the improbability, and even the impropriety, of such legislation, and are content to have the free market for gold maintained without prejudice. In the long run, we believe, no good can come to the miner from any legislative interference with the status of the metal. Conditions more favorable to gold mining are assured in the ordinary course of events. In regard to improvements in mining machinery, it is noteworthy that several replies join in laying stress on the need for a machine for scraping and shoveling broken rock underground. "The great trouble", says one engineer, "is that all shoveling machines are too expensive, too cumbersome, and too heavy." What is wanted, he adds, is a machine that will work economically in an ordinary drift. We shall be publishing an exhaustive article on the subject at an early date. Many of those whom we interrogated are engaged in copper mining, hence the replies under this heading are especially interesting. Everyone, of course, would like to know when the big copper mines are going to resume their normal activity; so we asked the question. It will be noted that the replies give the date as early as the beginning of next year and as late as July—a difference of six months. If an average can be made in such a matter, it would point to the spring, say, March next. The condition of the copper market has improved considerably since the interrogatory was answered. We hazard the forecast that the resumption will not be general at first, because the low-cost producers will be willing to start before the high-cost producers, the divergence of interest being sufficient to cause a lack of agreement in policy. If the price of copper remains low, it is likely that the harmonious efforts of the big mining companies to sell their product jointly will cease, and there may follow keen efforts for the domination of the market on the part of the low-cost producers, notably those who control the so-called porphyry mines and the bonanzas. Several of the replies from Arizona exhibit just resentment at the money wasted in that State by lavish legislative appropriations. The claim is made that several mines can produce and market their copper at New York for 10 cents per pound. Many efforts are being made to decrease the costs of operation by better methods and mechanical devices, so that the period of inaction is not unproductive. All the responders are awake to the need for widening the market for copper products, and approve of the Copper & Brass Research Association, which was organized recently for that very purpose. We venture to direct attention to the need for co-operating with the retailers. It is likely that ultimately some of the copper companies will unite in fabricating copper and brass products on a large scale, imitating the good example set by their competitors in the zinc-mining industry—for zinc has superseded copper in many articles of manufacture. Complaint is made of the high cost of intermediate crushing. For this, we believe, a remedy is forthcoming in the shape of a new crusher, which is proving to be extraordinarily effective, and cheap in its operation. One answer names the need for an improved method of removing the water in a flotation concentrate; another shows worry over the proper treatment of lean and mixed (sulphide and oxidized) ores. That is an old trouble, and is unlikely to be overcome definitively, for the better the metallurgical practice the leaner will be ore that can be beneficiated. Discontent is the penalty of progress; the progressive man is never content. The silver and lead producers are among the cheerful ones, as they ought to be, with silver at 73 and lead at 4.70. As regards lead, the outlook for American mines is excellent because no new and large deposits of lead ore have been found in foreign countries in recent years. The producers of lead, it appears, are doing nothing to promote the increased use of lead in the arts and crafts; presumably they are content with their market, although zinc paint has replaced lead paint in large measure during recent years. Electrification often involves the use of lead-covered cable, and therein lies the expectation for a largely increased consumption of both lead and copper. The zinc miner is unhappy chiefly because he has been spoiled by excessive prosperity; before the War he would not spurn the price that is now offered to him, but the high cost of living and the high cost of mining have dampened his enthusiasm for the time being. The return to the normal is slow and painful. The prosperity of the zinc miner marches with the activity of the iron and steel trades, for 60% of the zinc that is produced from American mines goes into galvanizing. Here we face the basic fact that the prosperity of one industry is dependent on that of another, as the welfare of one nation fluctuates with that of another. Interdependence is the keynote of the system of living we call civilization.

Profit-Sharing

Lack of understanding between employer and employee is usually a potent factor in causing labor troubles. A greater degree of co-operation between the various units of an organization produces better results; for then all alike become concerned with the outcome. A share in the profit of the day's work is one of the surest incentives to efficiency, economy, and the avoidance of waste; but managers have been slow to realize this important fact. The attractions of a paternalistic welfare scheme will never take the place of an additional ten dollars per week to the employee; increased effort will be made when the worker realizes that his care, his energy, and his interest have directly caused the extra profit; or, rather, they have avoided a corresponding loss to him, to his fellow-workers, and to the company. In a recent issue we drew attention to the method adopted by the Electrolytic Zinc Com-

pany, of Hobart, Tasmania, in dealing with the problem of post-war readjustment of expenses. Wages and salaries are to remain as before; but weekly deductions are to be made before payment, on a sliding scale, and ranging from 7¼% to 10½% of the amount earned. These deductions are to be placed to the credit of a trust-fund, to be converted into shares of the company, which will be held in the names of the workmen. Another attempt at closer co-operation between employer and employee is being made at Akron, Ohio, where all the 10,000 employees of one of the largest manufacturing houses—the Firestone Tire & Rubber Company—are now stockholders. Co-operation between employer and employee is close, and every facility has been provided to permit the men to take full advantage of the profit-sharing scheme. The common stock at par is issued on terms that permit payments to extend over a period of years. The workers receive reminders, in the form of increased pay, of the beneficial effects of zeal, attention, and increased production. However, profit-sharing is not new. Mr. Samuel Cabot, in 'Co-operation' describes the results of the application of the principle at his works during the past 17 years. Every man who enters his employ, and who wishes to benefit from the profit-sharing scheme, is required to sign an agreement to the effect that, in return for the privileges accruing, he will do his work as quickly and as carefully as possible, and will give 60 days notice before leaving. At the end of each half-yearly period a definite proportion of the profits is distributed among the employees who are so entitled. The sum is divided into two equal parts in each case, one of which is given in cash to the employee, the other being deposited in a savings bank, the employer acting as trustee. The fund in the bank is in the nature of an insurance upon the life of the employee; if he dies it is handed over, with accrued interest, to his executors. In no case, however, does it return to the employer. If a workman should leave without having given the agreed notice, or if he be discharged, the money is distributed among the participants remaining at the next division of profits. In case of sickness the employee is empowered to draw upon the fund; or cash may be advanced from the balance to assist the employee in the building or the owning of a home. The result of the scheme has been a marked increase in efficiency; it has stimulated sobriety and thrift; it has assisted many to own property, thus surrounding the works with the homes of those who are financially interested in the success of the undertaking and the development of the neighborhood. Statistics show that whereas the first profit-sharing payment amounted to about 10% of the wages of the men, the most recent one represented more than 20%. In view of the increase in wages during the period over which the scheme has been in practice, the improved earning capacity of the men is a significant feature. Mr. Cabot attributes this to superior morale, coupled with greater contentment and willingness—conditions that have arisen as a result of the recognition of a mutual interest between employer and employee. Socialism and its more radical sequelae gain many adherents during labor disputes, particularly when these are accompanied by the cessation of work, by poverty, and by idleness. In many cases this condition may be avoided by the adoption of a spirit of frank co-operation on both sides. The employer is usually in the better position to make the first move.

Revision of the Mining Law

Since the beginning of July we have published 22 letters on this subject, following the statement of the text of the proposed law in our issue of June 18. Most of the letters have come from prospectors and small operators; others in the business seem to be unwilling to endorse the proposed revision, although it is the work of a group of distinguished mining engineers, co-operating with the U. S. Bureau of Mines. The prospectors are agreed in condemning several of the new regulations, more particularly in regard to the locating of claims on cardinal lines and the connecting of them with the Public Land surveys. It is asserted that much of the public domain—the territory most likely to be prospected—is unsurveyed, and that even the surveyed portions were surveyed so long ago that in many localities the section-corners have been destroyed or obliterated, so that the prospector cannot 'tie' his claim-lines to them. As to this objection, it is usual, we believe, to comply with a similar regulation when obtaining title to agricultural land. Objection is raised to the provision for recording locations at the nearest Federal Land Office; the prospector prefers the neighborly County Recorder. The cost and delay involved in the required surveys and the verification of 'discovery' by a U. S. Deputy Mineral Surveyor are other points that provoke the prospector's irritation. He objects strongly to the clause granting an extension of time for five years on locations without discovery on the payment of $50 per acre in lieu of assessment work, that is, at the rate of $2000 per annum on the new 40-acre claim. This would enable rich men to hold large acreages without discovery and without doing work, while waiting for some neighbor to develop the adjacent ground to common advantage. Nor does the prospector appreciate the alternative of paying $100 in cash in lieu of the ordinary annual assessment work, because he sees in it only so much less employment for local miners; and as for the 'development fund' into which the money goes, he fears it will be wasted in bureaucratic performances of an academic or political character. The prospector is but little concerned with the benefit supposed to accrue from the abolishment of extra-lateral rights, because the menace of litigation does not bear upon him as it does on the owner of large mines. Similarly the waiving of 'discovery' is no boon to him; he looks upon the change as an aid to the acquirement of large acreages by the capitalist. The chief objection to the 'discovery' requirement was the fact that it was too frequently evaded, dishonestly. The same criticism applies to the usual evasion of the work required annually. Both this requirement and that of 'discovery' are objectionable because they incite dishonesty—untruth in

word and in action. Any law that fosters such practices needs to be changed or abrogated. Evidently the revised law is thoroughly objectionable to the prospector and unwelcome to the small operator, but it appears to suit the mining engineer, who, one must acknowledge, looks at the matter largely from the standpoint of his client, the capitalist. Indeed, some bitterness is shown in the correspondence; the mining engineer is depicted as inimical to the prospector and small operator; one writer asserts that "the mining engineer has very nearly killed prospecting since we lost the small promoter". With this we do not agree, and we would like to publish one or two letters from representative engineers correcting this false impression. Most mining engineers are kindly disposed toward the genuine prospector; they appreciate the useful work he does and they would like to help him. It is true, however, that mining engineers, especially the leaders of the profession, are the business associates of capitalists and are retained by large companies, so that, in such a matter as the mining law, they are likely unconsciously to regard it from the point of view of their clients. Probably the proposed revision might have been more satisfactory if representatives of the prospectors and small operators had been consulted. Perhaps they were; as to that we do not know. Speaking as detached onlookers, it seems to us that the chief objection to the revision of the mining law is that it comes too late. Our mining districts are plastered with claims to which extra-lateral rights have been conceded; to introduce now a new set of claims without such rights may only increase the confusion, such as has occurred already where placer claims have come into conflict with lode claims. We welcome further discussion from mining engineers and particularly from those who took active part in framing the revised code.

Gold and Oil

Somebody once philosophized to the effect that opportunity knocks but once at any man's door. Perhaps the individual who made this observation lived in some secluded nook at a distance from the main thoroughfares of traffic, where opportunity inadvertently passed him by when making its busy rounds; or perhaps the primitive methods of travel and the general inefficiency of former days prevented opportunity from making regular and frequent calls at every man's door. In any event we insist that the theory of one visit per generation cannot apply to our own times. We have definite proof, for within the last half hour—in the last mail, to be precise—opportunity has knocked insistently at our own door, not once, but twice. First, through the medium of one Marshall Spoonts, of Fort Worth, Texas, whose "bank-book shows that in the past six months I've made over One Hundred Thousand Dollars ($100,000) [count them] for myself", not to mention sundry fortunes that he has 'made' for his friends. Mr. Spoonts attributes his remarkable success "to this fact alone, that the man who plays the game square and always does the right thing by his friends is bound to succeed". To which we venture to remark that one way of keeping friends is to avoid giving them away. That we are fortunate enough to be numbered among Mr. Spoonts' friends is manifest from the salutation in his letter, which reads "Dear Friend". He appropriates to himself "all the honesty and integrity of a man who has led a Christian life for 43 years", and allows that he has practised the golden rule since he was four years old. We wonder if these admirable traits qualify him to induce the sands of Texas to gush their oil more voluminously or more willingly—for Mr. Spoonts' purple phrases are lubricated with Texas oil. The naive form-letter that is provided for our convenience as an investor reads as follows:

"Marshall Spoonts, Trustee,
Oil Operators Trust.

"With the understanding that you have made thousands of dollars for yourself and others off your investments in the oil business in the past few months, and will invest my money as intelligently as you would your own, I am enclosing $..... for ..... Interests (One dollar per Interest) in the Oil Operators Trust. I desire you to personally represent my interests in the Texas oil fields, and to invest this money for me as you would your own. It is also understood that all properties acquired by the Trust shall stand as security for my investment. I agree for you to retain half the actual net profits which you can make this money earn for me, forwarding me the other half of all net profits."

We spare the reader any further description of the entertaining literature that accompanied this generous offer, and proceed to the second enticement that opportunity put in our way. This time that other much-relished bait for the unwary—alluvial gold—formed the motif of a dissertation on a means of realizing a 'guaranteed' minimum return of $1,000,000 by investing $150,000, the gain being represented by 10% of the net profit. The letter of transmittal is signed by "W. E. Parker V. P.", of the Mines Operating Company, 400 Lexington Avenue, New York. The company desires to let a contract to some enterprising engineer for mining a channel of gravel 6 feet thick and 60 feet wide underlying Lightning creek in the Cariboo district of British Columbia. It is frankly stated that the "simple reason a contract proposal is made is because the previous financing and operating work was piled on one man who desires to be relieved of some of this excessive strain". Our sympathy would be more profound if the undertaking were more difficult than is indicated by this illuminating paragraph, which among other things shows what may happen when gold breaks loose:

"The object of this tunneling is to secure a lot of loose gold running at the rate of about 7½ millions to the mile, which is mixed up through the sand and gravels which are taken out. Two miles of this same ground has already been tunneled out and 15 millions removed, of which about 90% was profit. There is about 12 millions to be removed from this mile and a half section already pre-determined, of which fully 90% will be profit. The property is now equipped for all operations with the exception of a truck, a spare or surplus turbine-pump, and small supplies and store goods."

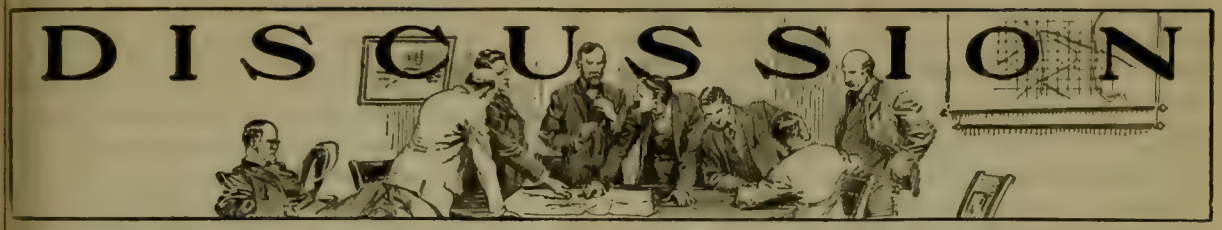
The financing and management of such an enterprise

ought to impose little "strain" on anyone; like some other mines, it is so rich, according to the promoters, that it would be impossible to make a financial failure by mismanagement, and the few thousand dollars necessary to buy the additional equipment ought to be procurable any day from the waiters at the Waldorf. An interesting feature of the letter is a drawing showing the cross-sections of the river-channel, with its underlying clay, gravel, and bedrock; and vividly depicting mining operations. The lack of timbering makes us solicitous for the safety not only of the exceedingly diligent miners but of the frock-coated and stiff-hatted gentlemen—whom we take to be capitalists—who are gingerly inspecting the workings. We hope that the 'roof' does not fall, and that the visitors are so favorably impressed with what they see that they will undertake to finance the enterprise, taking advantage of the chance that has doubtless been offered to them as well as to ourselves. However, we are not greedy, so we pass it on to our 'friends', being confident that 'opportunity' will call on us again.

Metric Weights and Measures

Hearings on a Bill to provide for the compulsory adoption of the metric system of weights and measures are to be conducted by a sub-committee of the Senate Committee on Manufactures. The sub-committee is to hold a limited number of hearings, so that the proponents and opponents of such legislation may have an opportunity to state their views on the subject. A stenographic record of each hearing will be circulated as soon afterward as practicable, so that the public may become acquainted with the problems involved. Later, during the regular session of Congress, it is proposed to hold further hearings; definite action may then be expected by the committee, followed by the placing of the Bill on the calendar of the Senate. If it becomes law it will provide that, after the lapse of ten years, no person shall sell anything (except for export), or charge or collect for carriage or transportation, in or according to any other than on the metric scale. The American Institute of Weights and Measures is opposed to such a change; it deplores the possibility that trade, wholesale and retail, may be conducted according to a system that is strange to our people; it contends that all postage, excises, duties, and customs charged and collected by the Government will have to be based on a standard, the units of which bear no simple or easily remembered relation to the weights and measures now in use; it emphasizes the aspect of compulsion under which the American people would be obliged to discontinue the use of the English units, in favor of "the kilometer, the hectometer, the dekameter, the centimeter, the millimeter, the kilogram, the hectogram, the dekagram, the gram, the liter, the dekaliter, the hectoliter, etc., etc." We are not prepared to give an unhesitating support to the Bill in question; at such a stage we are, naturally, 'from Missouri'; but we consider that the Institute's arguments will serve to strengthen the position of those who are in favor of the change; for one thing, its attitude considers the present and not the future, ourselves and not our descendants. Had it not been for the foresight and unselfishness of our ancestors a century or more ago we might today have been wasting our time and energies on a system of coinage in which four farthings equal one penny, twelve pennies equal one shilling, and 21 shillings equal one guinea. The loss of time in educational institutions in countries in which such systems are in vogue is appalling. If we considered those who will come after us we would adopt a simplified method of recording weights and measures without delay; Great Britain is waiting for the initiative of the United States in this respect.

The American Institute of Weights and Measures draws attention to the expense that would be entailed by manufacturers if the metric system were adopted. Thus, we are told, a firm in New Jersey reports that the change would involve a cost to the company of $900,000, which, as the number of employees is 900, amounts to exactly $1000 per worker; another firm in Michigan states that the introduction of the new standards would mean an outlay of $3,000,000, which, distributed over 6000 employees, represents $500 per head. Such statistics are far from convincing. Even if the figures were plausible their publication would constitute no conclusive argument against the change. The writer of these notes has lived in countries in which the metric system was unknown, in which it had been partly adopted, in which it was in use in conjunction with other units, and in which it was legally compulsory. The advantages in the complete abandonment of all other systems were obvious. When the Institute endeavors to obfuscate the issue by drawing attention to such measures as the "hectogram" and the "dekameter" it is 'playing to the gallery'. Intelligent Americans appreciate the simplicity of the metric system and the complexity of our own units of weights and measures; the schoolboy knows that such prefixes as milli-, centi-, and deca- are self-explanatory; if a change be made there should be no difficulty or trouble in quickly understanding the proposed alternative. American engineers, when in countries in which the metric units are used, appreciate the enormous saving of labor and calculation that results from a complete abandonment of the English system; but it must be discarded entirely; its use must be prohibited by law. The point made by the Institute that the units of the metric system bear no simple or easily remembered relation to the weights and measures now in use constitutes a feeble argument against the change; the old archaic form of reckoning should be discarded and forgotten if any change be made; other nations will soon follow suit; those who wish to preserve their connection with the unprogressive past will do so at their own loss. America faces the future; and if the introduction of the metric system of weights and measures will simplify national life for us and for our descendants, if it will decrease labor, if it will encourage accuracy, then its adoption is as certain as was the adoption of the decimal system of coinage in 1787.



Revision of the Mining Law

The Editor:

Sir—As comments on the proposed amendment and codification of the mining law are invited, you will perhaps give me space for a few suggestions and comments from the point of view of a lawyer who has seen the workings of the mining and public land laws.

The purpose of the proposed changes should be, and doubtless is, to simplify the law, to make more clear the benefits and property rights that may be acquired under it, to do away with some of the dangers and burdens to which property so acquired is exposed under the present law, and to give greater encouragement to the exploration and development of the public mineral land.

Chief among the dangers and burdens under the present law is the right to follow a vein from its apex under the surface of another, known as the law of the apex or the extra-lateral right. This right was given by the law at a time when the discovery of the vein and its pursuit into the ground were the objects of the miners; the law gave legal sanction to the customs established among them. This principle was suited to the early times and conditions—it applied to lode mining only—never to placers. As mining districts grew, however, the dangers of the system became apparent. One could seldom know with certainty whether an orebody which he had found belonged to himself or to another unless he acquired all the surrounding ground. The cost of litigation over these rights and of settlement of claims based upon them became appalling. There has been some difference of opinion among lawyers on this point—the old view still has its advocates—but I am of those who think that the greatest service a lawyer can render to his client, when an apex question seems likely to arise, is to advise him to acquire the adjoining claims or to make side-line agreements, so-called, for perpendicular boundaries. The latter is exactly what the proposed law accomplishes. It does away with the extra-lateral right wherever it is not already vested. It makes the lode claim like a placer claim; all distinction between them is done away with. This alone is so great a benefit as to make up for many minor defects in the proposed law if such there be.

As a logical outcome of that main purpose, the shape and size of claims are changed. Instead of long segments of the vein the prospector is given rectangular pieces of land conforming as far as possible with the lines of government surveys. All this is to the good.

There seems to me to be a defect in the proposed law in that not only discovery and assessment work but even work looking to discovery may be postponed for a number of years by the mere payment of comparatively small sums of money; and lands may thus be held without any exploration or development. This is a departure from the theory that the law ought to encourage exploration and development; and there is not the excuse for it, if the extra-lateral right is abolished, that there might be under the law as it now stands. Under the present law work is required; constant exploratory work until discovery; some actual development work each year thereafter. It may be said that that requirement was often evaded and that the sure money-payment takes its place—that is true, but the law ought to require work instead of money, so that the character and value of the land can be ascertained and made the most of.

There are probably other good points and other defects in the proposed law that are obvious to the engineer or the practical miner. These are the points most obvious to the lawyer. Intelligent criticism will help the final outcome. If no particular interest is shown no law will be passed; if all those interested in mining do show an interest and commend or seek to improve it, the proposed law, or something better in some of its details, will be passed.

HENRY F. MAY.

San Francisco, October 5.

The Editor:

Sir—In discussing the revision of the mining law there is one point that, I believe, if followed up would lead to a better understanding of the question, and, perhaps, to a solution. It will be noticed that there are some cases, which nearly everyone, to some extent, seems to be aware of, to which the proposed law cannot be applied without harm. On the other hand, it will be noticed there also seem to be other cases where one feels its application, with modifications, would be beneficial. I say "feel" because we are unable to state exactly why we feel or believe as we do. It is only after considerable thought that we are able to give reasons for our belief. What we wish to discover is the distinguishing features in these two cases, with the idea of framing a law, if possible, that will cover both cases. As it is now, we are put in a position of choosing between two evils. If we choose the present law we get something that has its advantages and disadvantages; if we choose the proposed new law we get something that is an advantage in one place but a disadvantage in another.

The proposed new law would be a great disadvantage

in mining comparatively narrow veins, particularly if they have a flat dip; because it would necessitate a great amount of ground to be located—in some cases, where the vein runs diagonally across proposed divisions, ten times as much ground as the present law calls for—in order to prevent the economic unity of the vein being destroyed. In other words, the failure to do this would tend to cause the ownership of a vein to be so divided that it could not be exploited economically. This division of ownership is, also, likely to cause many trespass suits. Furthermore, making a company or an individual acquire so much surface ground, in order to mine a particular body of mineral below, makes unavailable ground that may be useful for other purposes, and may, perhaps, prevent the use of other available capital. It should be remarked that the mining of ore from a comparatively narrow vein, even if flat, in no way destroys the use of the surface for other purposes, as would be the case if the orebody was large and flat.

In the case of a large orebody, if it dipped beyond the vertical plane of its side-lines, and didn't dip very flatly, it would be a blunder to have its economic unity destroyed by a regulation like that in the proposed new law. It would certainly be wrong to run the chances of having the economic unity of a mine like the United Verde or the United Verde Extension destroyed by such a regulation.

The proposed new law should not be applied to any narrow vein—comparatively narrow vein—or to big bodies of ore where their dip is fairly steep, that is, so steep that the surface above is not likely to be disturbed by taking the ore out below. But it should be applied to large flat-lying bodies of ore, like the porphyry coppers, and to other flat-lying deposits, like those found in a limestone formation. In the case of the porphyry coppers there are three reasons why the surface above the ore should be owned and purchased by the owners of the ore. First, the mining operations are likely to spoil the surface for other purposes. Second, the orebodies being flat and so large requires the possession of the surface above them in order that the ore may be more economically mined through many different shafts distributed over the surface. Third, prospecting for the ore below is carried on easier from the surface by means of drill-holes. For this reason alone, if for no other, the ownership of the ore below and of the surface above should go together. Another reason why the proposed law, or rather a modified form of it, and not the apex law, is applicable to the porphyry coppers and similar deposits, is that the locating of claims along the edge of a flat-lying deposit as one would along the outcrop of an ordinary vein, would take in so much ground that it would hinder the discovery of other valuable mineral, and would also hinder the employment of available capital. The ownership of the surface by others would hinder prospecting. The proposed new law, with modifications, should be applied to mineral found in limestone, because the ore deposits in this formation are, as a rule, found in bunches, and, as a consequence, the discovery of them would not be furthered if enormous areas could be easily acquired by one individual or organization, as would be the case if a stratum of limestone, in which the ore occurred, could be located litke a quartz vein, and followed to any length along its dip. Such a thing would also keep a lot of available capital from being employed. There is no objection to the amount of ground an individual or a company may acquire so long as they make use of it or don't hinder others from making use of it. There is another place where the present law doesn't seem to apply. That is where a number of different veins and faults run and cross and pitch in as many different directions. As, for instance, in the Butte district.

There are two things we have to guard against: one is destroying the economic unity of an orebody, and the other is the acquisition by any person or persons of more than they have need of, or can handle. In other words, guard against any dog-in-the-manger business. The idea I wish to convey is that there are mineral deposits or veins to which the present law applies best, and other mineral deposits to which it does not apply—other mineral deposits to which the vertical side-line law applies best. Why not classify all mineral deposits and apply both laws? Classify all mineral deposits into, say, three classes. (1) Those deposits or veins to which the present law is plainly applicable. For instance, such a vein as that of the Congress mine, in Arizona, which is very regular, well-defined, and comparatively narrow, and has a dip of about 23°. (2) Those deposits to which the vertical side-line law is plainly applicable. For example, the porphyry coppers. (3) Those deposits that are on the border-line between these two. In this case it could be made optional with the locator whether he located under one class or the other. To make both forms of location equally inviting, the location calling for vertical side-lines should be made larger. By making both these forms of location equally inviting, the possibility of litigation will be the determining factor in deciding the form of location. If this is not considered satisfactory, each district could decide what form of location should prevail.

WILLIAM CROCKER.

Prescott, Arizona, October 4.

Big Bend Vein-System

The Editor:

Sir—There occurs about 16 miles above Oroville on the north fork of the Feather river a series of parallel quartz veins striking north-west, and dipping at rather flat angles to the eastward. These veins occur in both amphibolite schist and granodiorite, the latter forming the backbone of Big Bend mountain. The veins in the schist seem to be stronger and both systems carry gold and silver. The predominating minerals of the veins in the schist are pyrite, chalcopyrite, some sphalerite, traces of galena, and occasionally a little barite. Gold and silver are found wherever chalcopyrite predominates.

Oxidation and consequent 'differential enrichment' were responsible for the discovery of the so-called Sur-

cease vein, which was traced by the gold it 'threw-off' from a point at least a mile below on the river. This tracing was done, after the custom of the district, by panning. The Surcease vein was successfully mined in the oxide zone to a depth of about 50 ft. a few years ago by underhand stoping. Sulphides came in at this depth, chalcopyrite predominating, and the content in precious metals held fairly constant to the present depth of the mine, which is about 300 ft. below the first point of attack on the outcrop. Two normal faults dislocate the present ore-shoot at an interval of some 500 ft. Both faults are post-mineral.

The schist is extremely dense in its unaltered state and it is probable that the mineralization may be akin to the Mother Lode gold belt, and due to hydrothermal action, the fissure acting as the line of least resistance to ascending mineral-bearing solutions. The density of the schist has prevented dissipation of valuable mineral content by impregnation, and consequently has caused the concentration which is now the Surcease vein.

If the above be so, the vein could be expected to persist in depth. More development would be interesting. I submit the above brief personal deductions in the hope that other engineers who know the property may voice their opinions as to this line of reasoning and consequent possibilities of this district.

ROBERT J. BURGESS.

Tuolumne, California, September 28.

A Milling Method

The Editor:

Sir—A novel treatment is being given the gold-silver ore of the Juniper mine, at Hayden Hill, California, and a short description of it may be of interest to your readers. The gold and silver are found in veins of rhyolite that intrude through rhyolite-breccia. The precious metals are in a detached condition, that is, they are not affixed to the vein-matter but are retained in the cleavages of the rock by a clayey material of which the veins are partly composed.

The ore as broken in the mine is delivered through an inclined shaft to a pocket at the surface. In this pocket a grizzley has been placed, to discard as waste all material larger than 10 in. diam., the finer material being trammed to the mill. Above the mill-bin is another grizzley, which allows all material finer than 6 in. diam. to pass to the bin, the remainder going to a jaw-crusher, which reduces it to less than 6 in. From the mill-bin the ore is fed, by a Challenge feeder and belt-conveyor, to a trommel 16 ft. long and with a diameter of 40 in., having 1-in. openings, and revolving at 18 r.p.m. The trommel has internal sprays distributed throughout almost its entire length.

The plus 1-in. portion of the ore, after passing through the trommel and being washed by the sprays, is discarded as waste. The minus 1-in. portion is conveyed by a drag-belt to two 5-stamp batteries, the surplus from the sprays furnishing the water for the batteries, where it is crushed to pass a 20-mesh screen; after which it passes over amalgamating-tables, one for each battery, 3 ft. long by 5 ft. wide. The rest of the amalgamating-tables, 12 ft. long by 5 ft. wide, is covered with two equal lengths of brussels carpet, having a drop of $\frac{1}{4}$ in. between them and $\frac{1}{2}$ in. between the plate and the carpet. The bed, or table, is inclined at about one inch per foot. The carpets are removed at two-hour intervals, washed, and returned to the tables. The product resulting from cleaning the carpets is placed in a clean-up barrel with mercury and other chemicals, the barrel revolved at 20 r.p.m. for four or more hours, when the gangue-material is washed over a jig, the amalgam separated and collected. The tailing, after passing over the carpet, is pumped to a hydraulic amalgam-trap, from which it goes to a 24 by 8 ft. Dorr thickener. A diaphragm-pump passes the thickened tailing to a waste-pond. The overflow is returned to the battery-tank, to be used over again through the trommel-sprays. In this manner about 60% of the material sent to the mill, assaying about $25 per ton, is rejected from the trommel. This reject assays 60c. per ton. The tailing from the remaining 40%, after amalgamation and carpet treatment, assays from 80c. to $1.20 per ton.

In submitting the above I make no claim of having put into operation any new method, but as the combination has proved a great success on the treatment of this particular ore it may be possible that others may find it useful.

G. W. GILMAN.

Hayden Hill, California, September 26.

To Help the Prospector

The Editor:

Sir—Some time ago I observed in your paper a reference to the subject of how to revive prospecting. In all that was said there was much of interest, but no remedy was forthcoming that would serve the purpose of reviving interest as in previous times, for, in the end, the prospector, who must assume all the obligations attached to his business, and is only successful by virtue mainly of his limited resources, soon finds himself unable to pursue his business to a fortunate conclusion. One of the most discouraging features of the life of a prospector is that it often happens that he makes what he feels will prove to be a favorable find at a time when his last pot of beans may be on the fire, and he is then obliged to seek work, perhaps at some mine many miles away or at some other remote place until such time as he may be able to gather enough together to resume his prospecting. In the meantime, his location, by reason of the lapse of a few months since he was upon the ground last, has been forfeited to someone else, who now also may be in temporary possession—perhaps another prospector like himself.

The reason that causes this prospector to lose his rights to the ground, which had cost him many days of hardship to find, was the lack of capital to complete his work properly, as it should be done. Just how many are the favorable prospects that are now awaiting development

because of the lack of a little money on the part of the prospector—who may only need assistance to the extent of sinking or driving a few feet to make his prospect attractive to capital—no one but the prospector himself will ever know, for he has long since learned to conceal such finds as he makes in his wanderings, knowing as he does how unfruitful any efforts he could make to interest anyone would be, because of the lack of interest that people in general show toward him and that of the business that he follows—all because it is not founded upon or built upon a substantial business basis. Who, then, is at fault, and what is to be the remedy? Something must be done to stimulate prospecting, or in a few years hence there will be few mines in process of development to take the place of those becoming depleted of their ore-reserves. This is a matter of grave concern to the general welfare of the country, as will be admitted.

We have many provisions in our laws to protect the Government, but few, if any, to encourage the business of prospecting. All our mining laws provide adequately for the protection of the Government in forfeiture clauses, but nowhere is there any provision made to protect the pioneer in his work against ultimate loss, as it is customary to recognize and provide for in any other line of business or pursuit. If, perchance, as only too often happens, the prospector may be financially embarrassed, he must suffer his claims to be lost to him with no reward or re-payment in any way to come to him for his work. After the expenditure of his means and energy, not infrequently having lost his health and may-be in the later part of life, he can look back upon his efforts, in their having first brought to light some pay-streak or showing that later others having acquired, when he was obliged to quit, had developed into a property of value. He had in his pioneer work led the way, but reaped no reward, which all will acknowledge, is decidedly wrong, in justice, and should be corrected.

The Government had in mind the protection of investors in the development of its public lands when, in the Carey Act, it incorporated certain provisions (see page 50, Document No. 547, Public Land Statutes of the U. S.) providing that "a lien or liens is hereby authorized to be created by the State to which such lands are granted, and by no other authority whatever, and when created shall be valid on and against the separate legal subdivisions of land reclaimed, for the actual cost and necessary expenses of reclamation until disposed of to actual settlers". As a further citation of this same attitude toward the investor on the part of the Government, it is noted (page 289, above mentioned document), referring to canals, ditches, and reservoirs (Sec. 20), "that the provisions of this Act shall apply to all canals, ditches, or reservoirs hertofore or hereafter constructed by corporations, individuals, or associations of individuals, on the filing of certificates and maps herein provided for. If such ditch, canal, or reservoir has been or shall be constructed by an individual or association of individuals, it shall be sufficient for such individual or association of individuals to file with the Secretary of the Interior and with the registrar of the Land Office where said land is located a map of the line of such canal, ditch, or reservoir, as in case of a corporation, with the name of the individual owner or owners thereof, together with the articles of association, if any there be. Plats heretofore filed shall have the benefits of this act from the date of filing, as though filed under it; provided, that if any section of said canal or ditch shall not be completed within five years after the location of said section the rights herein granted shall be forfeited as to any uncompleted section of said canal, ditch, or reservoir, to the extent that the same is not completed at the date of the forfeiture".

In so much as the prospector and miner are engaged in the development of the resources of the country, spending their time and money and thereby acting in as good faith as the party or persons developing the farming lands, there appears to be every reason why he should have the same consideration as those who are protected against ultimate loss by the Government in the manner as above outlined. It would seem as though this was something that was his due and but a matter of justice, that he should have the same benefits accrue to him as those provided for him who prepares lands for farming in advance of their producing crops. I am inclined to the view that it is no fault of the legislative branch of the Government that some such provision has not long since been made, but may perhaps be attributed to a lack of proper consideration and study being given this matter by those who are in power. It is perhaps something that has been overlooked, but should be overlooked no longer, for there is need for some early and specific action, and I believe that it is a matter that would have the support of everyone familiar with this phase of the prospector's lot in life and that of the mining industry, which is indebted to his perspicacity for what it is today.

Were some such provision made, it would give the prospector and pioneer in mining a lien upon the ground that he locates upon the public domain for all the money and time that he might expend in its development, filing a lien in somewhat the same manner as that now in practice with the development of land, at the nearest Land Office, and having this a matter so recorded that in the event he was unable to go on with his development and the land were to be located by someone else, this lien would be entitled to first consideration whenever the mine became a producing property and returning to its owners any revenue with which such claims as this and any other of a similar character, made by other prospectors or miners, in the order in which they became possessors by location, should be paid.

If some such provision as this were to be made, no doubt there are many prospectors and mine-owners, who, feeling that they cannot personally command means to proceed with the development work necessary, or, who for any other reason are unable to explore their mining claims, would elect to make the filing that would be required for their protection with the local Land Office and

retire. I fancy that there are many old-time prospectors who would welcome such a chance, that would relieve them from being burdened in their remaining days with the annual assessment work, by being now able to have this feature finally disposed of, as an obligation that would no longer be required to safeguard their rights. The U. S. Land Office may thus be made to serve the purpose of a clearing-house, because of the great number of relinquishments and filings that would be made by those interested in the development of the promising prospects and mining claims of the country. Surely it would appear that investors would be greatly interested in learning at the respective land offices as to what there may be open to them for investigation and location in the way of prospects that have been already discovered and somewhat developed. This suggests that because of this increased interest and the development work that would in a great many instances follow, the mining regions would profit greatly, where now little or nothing is being done. The prospector or mine-owner would always possess the advantage of giving up a portion of his holdings by the filing of relinquishments and retaining those which he may be able to do his development work upon, instead of relying entirely upon himself, and as often happens being obliged to develop a district alone. His relinquishments would attract others to come to his aid in the development of such claims; this incidentally would make the holdings that he had retained more valuable. Finally, it is well to emphasize, there remains an insurance to the man who had the courage and pluck to give his time and money freely in the early development, with the assurance that, if ever such prospects may prove to possess value and develop into paying mines, he at least will be paid something for his expenditure of time and money in its initial stages of development. As a lien-holder, he has this guarantee, which is never to be lost to him, because he may for some reason or other be obliged to forfeit his right to the claim he owned. If his own energy, purse, and resources proved inadequate to ensure the success of his own efforts, he still has the lien as an asset that in the end will reimburse him.

As to the business features involved, the position of the prospector, in his ability to interest men of means in his prospecting and development work is greatly improved. If the man who first initiates the discovery work and those following him in the execution of development work, each in turn, would find it possible to be protected as outlined, then the business of each would become more stabilized, and, as a result, investors would be more disposed to extend financial aid as needed. With such a lien on file, the prospector's title would be materially benefited, it would be a great protection to him as against those designing to secure his locations without reimbursing him for such, and, whenever it came time to secure U. S. patents for his claims, his abstract of title would be somewhat simplified, better defined, and as a consequence command greater respect for final certification at the hands of the Government officials having the case in charge. Such patents, of course, would be secured in the regular way, by the payment of fees and the regulation price for mineral lands as now provided. The prospector or miner who proposes to hold onto his lands need be in no way interfered with, for he need not file his form of relinquishment until he decides to abandon his claim, and even then he may not be obliged to do so, unless it appeals to him that by so doing he will be aiding himself directly by virtue of this act inviting others to investigate the merits of his former claims, which, if they decide to re-locate and develop cannot but prove to his advantage in re-payment, as stated above, of the outlay he has made upon such.

In the filing of any relinquishment, the owner should be permitted, if he so choose, which I think he would be glad to do, to file with the U. S. Land Office a brief statement as to the nature of his discovery, and any information relating thereto that would be of interest. He might also give his permanent address, so that persons desiring to consult with him, with respect to such finds as he may have made, while the property was his, may do so. In this manner a prospector could give information to a re-locator that he would prefer not to embrace in the brief statement he would file with the Land Office. With such statements on file at the Land Office the prospector would be greatly benefited, for he would be able to find records of much value, which could be consulted, wherein, frequently, he would find it possible to save himself much time and expense in avoiding a needless duplication of work and expense.

JOHN T. REID.

Lovelock, Nevada, October 3.

Valuation of Placer Deposits

The Editor:

Sir—I would like to call attention to a point in connection with the valuation of placers, which, if true, explains some of the discrepancies between sampling estimates and actual recoveries, of which Mr. Gerald H. Hutton speaks in his article, 'Valuation of Placer Deposits'.

These discrepancies, I believe, to a great extent are due to a peaking or a ridging of high values, which, in all probability, occurs in every valuation of a placer deposit. That is to say, instead of the value of ground between holes gradually changing between high- and low-grade holes, as per theory (according to which the value of ground gradually changes between holes), the value of the ground falls off sharply near high-grade ground; and the farther away, the less rapidly the values fall.

I know of no facts or experiments that prove, directly, that this is the case; I base my opinion on theory, and on the ground that such a peaking or ridging explains the great discrepancies noted by Mr. Hutton.

I remember reading in the fore part of Le Conte's 'Geology' the statement that the carrying power of water varies as the sixth power of the velocity. This, I believe, would cause a peaking or ridging of high values. A slight change in the velocity of the water would make a comparatively great change in its carrying power. A de-

crease to one-half the velocity would cause the carrying power to drop to 1/64. Along any dry creek-bed one can see the evidence of this abrupt change in carrying power. What we know happens to gravel, happens also to gold. Small pieces of gold (not flake gold) are affected in moving water much the same as is coarse gravel, and will, most likely, be deposited near it. That is, the ratio between the surface and weight of small pieces of gold is approximately the same as the ratio between the surface and the weight of coarse gravel; it will, therefore, be affected much the same in moving water. In dry creek-beds one can often notice the way the coarse gravel piles up. So it is likely the coarse gold does the same.

To avoid over-estimation, on account of this peaking or ridging effect, the best practice would seem to be a closer spacing of holes around extremely high-grade holes.

WM. CBOCKER.

Prescott, Arizona, September 16.

Valuing Partly Exhausted Mines

The Editor:

Sir—In your issue of March 19 appeared an article by Morton Webber in which was discussed the valuation of closed mines, either caved or flooded. While agreeing with the ideas there presented and deeming it unnecessary to call further attention to the excellence of his presentation, I wish to point out some false assumptions that were made in the period of initial risk. On page 389, Example B shows a longitudinal projection of an ore-shoot having an hour-glass shape. The pitch of the shoot is approximately 45°. Below the middle of the hour-glass are four levels, the 800-ft. level being the lowest opened. The length of the drift in ore is greater than on any level above. Mr. Webber says: "The 800-ft. level was re-opened and the floor sampled. At this stage the gamble looked attractive, for, among other features, *the ore-shoot seemed longer than on any level above.* The information of the 900-ft. level was then not known. This should be understood to appreciate the situation as of that time. *There was nothing to show that the pitch of the ore-shoot was flattening,* and that the increased length of the level was due to the fact that the plane of the level was approaching the major axis of the shoot. All the levels above the 800-ft. level were caved". The italics are mine.

I do not see how one can assume logically that the increased length of the 800-ft. level in ore in any way indicated that the width of the ore-shoot was at a maximum there. Mr. Webber shows that it was known that the ore-shoot had narrowed at *A-B*. A line *X-Y* drawn from the mid-point of this narrow portion to the mid-point of ore on the 800 and another line *C-D* drawn normal to it from the 800 station would have prepared the way for a more logical estimate of the probable extension of the shoot. Regardless of flattening pitch, one might reasonably assume that as much ore would be found below *C-D* as between *A-B* and *C-D;* and one could not wisely assume any greater volume as probable.

The initial risk of the 900 was perhaps justified, but the point I wish to make clear is that the assumptions I have italicized were not reasonable or natural at the time they were made. The results of the development on the 900 should have been foreseen, at least as an extremely probable alternative to increasing width of ore. It seems to me that there were only two logical assumptions possible: one that *C-D* was the maximum width of shoot, the other that a line through *K* parallel to *C-D* might be longer and prove the shoot to be widening. Safety would suggest the first of the two. In other words, the chances were assumed to be favorable when it should have been recognized that there was an equal chance that the greatest width of ore had been passed in the upper levels. The length of drift in ore on the 800, in fact, was no measure of the width of the ore-shoot.

The 900-ft. level should have been driven with the purpose of ascertaining whether the major width had been passed. As soon as it had advanced, say half-way, the balance would have been thrown in favor of the assumption that the shoot was a lens of diminishing width.

It will be noted that the amount of ore actually found below the line *C-D* proved an apt illustration of the principle that in an ore-shoot of the type indicated between *C-D* and the surface, if a line be drawn normal to the pitch of the shoot from the point where ore is cut on the foot-wall on the lowest level, one may reasonably assume that as much ore will be found below this line as has been taken out above it, when this line is longer than similar lines on upper levels. Provided also there be no indications of drastic geological changes, which, I take it, there were not in this instance.

This article of Mr. Webber's has been subjected to critical examination in a class of senior mining students under my direction and has been most valuable to these budding engineers. May we have many more as well written and so full of sane reasoning on this most difficult and at times most trying phase of mine valuation.

L. O. HOWARD.

Pullman, Washington, October 2.

Pulverizing Coal for Use in Smelting

The Editor:

Sir—I was very much interested in reading the article by Mr. Arthur B. Parsons in your issue of September 17 covering the smelter of the Nevada Consolidated Copper Company.

This article is complete and, in view of the intimate knowledge which I have of the plant, true to the conditions existing, I feel that the 'Press' is entitled to congratulation upon the accuracy of this report.

In the description of the Roasting Department, on page 395, paragraphs 2, 3, and 4, I wish to add that in January 1918 I took out Patent No. 1,251,692 covering this device and that therefore the special features of the same are protected by this patent.

R. E. H. POMEROY.

Canton, Ohio, October 5.

FIG. 1. GOLD-DREDGE IN OPERATION

Shop-Operations and Repairs on Gold-Dredges

By Frank A. Stanley

The recovery of placer-gold through the medium of t dredging process is one of the most striking engineer- operations that may be seen in California and in o er far Western States. Something like one hundred n lion dollars in gold has been recovered in this manner d ring the past 20 years in California alone, and it is e imated that the dredges employed in the work have h dled about seven hundred million cubic yards of g vel during that period. These dredges, costing in m dern designs up to half a million dollars or more, are r harkable pieces of mechanical equipment; obviously t re is much of interest to be found in the methods of c struction, operation, and upkeep.

Typical views of gold-dredges in operation are pre- s ted herewith in Fig. 1 and 2; the former shows a com- p te side-view of a dredge at work in the pond, whereas F . 2 illustrates the appearance as seen from the ladder- e . with the long train of heavy buckets coming out of t water and passing up into the housing of the dredge. The illustrations that follow show features of the s p practice of the Natomas Company of California in connection with the making of new parts for dredges and the repair of old parts at the company's plant at Natoma near Folsom.

OPERATIONS ON LADDER-ROLLERS. Fig. 3 illustrates the method of boring out the shaft fit in cast-steel ladder-rollers. These rollers serve as idlers over which the buckets pass as they emerge from the pond; their positions on the ladder may be seen upon reference to Fig. 1. Like other of the moving parts these rollers are subjected to extremely severe conditions of service and they are mounted upon their shafts under heavy pressure. The shaft takes a bearing near each end of the roller; the operation of boring out the metal is similar to the sizing of a hole in any long hub where clearance is provided along the middle of the length of bore.

A typical roller has an external diameter of 16 in., and a face length or width of 4 ft. 1 in. The shaft is 5 in. diam. and in machining it allowance is made for forcing it into the roller under a pressure of 20 tons per inch of diameter or a total pressure of 100 tons. This pressure per inch of diameter is not far from double that commonly allowed in railroad shops in pressing locomotive drivers and axles together.

Abstracted from 'Western Machinery World', July 1921.

The method of boring the rollers requires little description. The work is mounted as in Fig. 3, in V-blocks upon the table of the horizontal boring machine and secured by V-shaped clamps over the top of the roller. With the work properly centred the cutter-bar is fed through to size the bore to the specified dimensions.

FIG. 2. VIEW OF GOLD-DREDGE BUCKETS

FIG. 3. BORING LADDER-ROLLERS

BUCKET-PINS. Another part subjected to wear is the bucket-pin, several of which will be noticed in Fig. 4. These pins are made in various sizes according to the size of the dredge, and will range up to over 7 in. diameter for the biggest dredges. There are 80 to 100 buckets on the big dredges and one pin to each bucket. The buckets work to a maximum depth of 80 ft. or more, encountering hard bed-rock reefs and boulders of all sizes. Consequently the pins which take the load of the operation are subject to severe conditions.

These pins are forged from chrome-vanadium steel and are machined to proper size of body and head. They are heat-treated, oil-tempered, and given the Brinell test for hardness. A record is kept of the time each pin is made and put into service. The record gives the serial number of the pin, the temperature under which it is

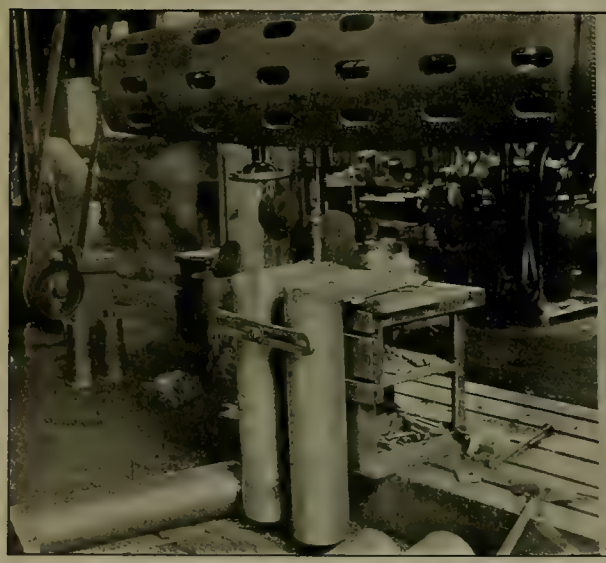


FIG. 4. DRILLING A BUCKET-PIN

FIG. 5. HEAVY PINION ON PLANER FOR CUTTING KEY-WAY

handled in the furnace as recorded by a pyrometer, and the Brinell hardness number.

The operation shown in Fig. 4 is the drilling of the head of the pin. This is accomplished by strapping the pins vertically to the side of the table of the radial drill where two pins can be conveniently secured by one strap.

FIG. 6. UPPER TUMBLER ON 25-IN. SHAFT

OTHER SHOP WORK. There are various heavy gears and pinions in the equipment of dredges and a shop operation on a coarse-pitch pinion is shown by Fig. 5. This represents the method of cutting key-ways in the neck of the pinion. The work is blocked-up on the platen of the planer and secured to the face of an angle-iron by straps at each side as indicated. The back end of the key-way of course has been drilled out in a previous operation to allow the planer-tool sufficient space to run out in its cut. In this instance two key-ways are cut 90° apart on the hub.

The broad nose, flat-ended gripping tongs suspended from the chain-hoist provide a handy means for picking up work of this character for placing in position for machining or for removing from the planer when finished.

THE UPPER TUMBLER. The buckets are operated over an upper tumbler which, in one form, is shown in Fig. 6. In some designs the tumbler and shaft are cast integrally. In this instance the shaft is a press-fit in the tumbler-bore and is keyed in addition. The steel casting weighs many tons and of itself is a heavy load on the shaft. The latter is a special steel hollow-forged member ranging up to a maximum of 25 in. diam. at the fit in the bore. The pull of the long bucket-lines comes on this tumbler and shaft; the extreme loads, and constant shock and vibration may lead eventually to a cracked shaft even where the dimensions are as liberal as noted above.

THE LOWER TUMBLER. Much use is made of the oxy-acetylene welding- and cutting-torch in dredge repairs. An operation on a lower tumbler with the cutting-torch is illustrated in Fig. 7. Owing to the drag of the long heavy line of buckets over this lower tumbler the surface wear is marked, particularly along the inner faces of the flanges which take the side-thrust of the bucket-line. The position of this tumbler will be noted at the extreme right of the dredge illustrated in Fig. 8.

The lower tumbler is a manganese-steel casting, very expensive to begin with, but endowed with long life through its original toughness and strength. The use of the cutting-torch in reinforcing such worn surfaces as occur along the inner faces of the flanges has been effective in greatly lengthening the period of service. In Fig. 7 the workman is shown cutting holes through the flanges so that reinforcing sections

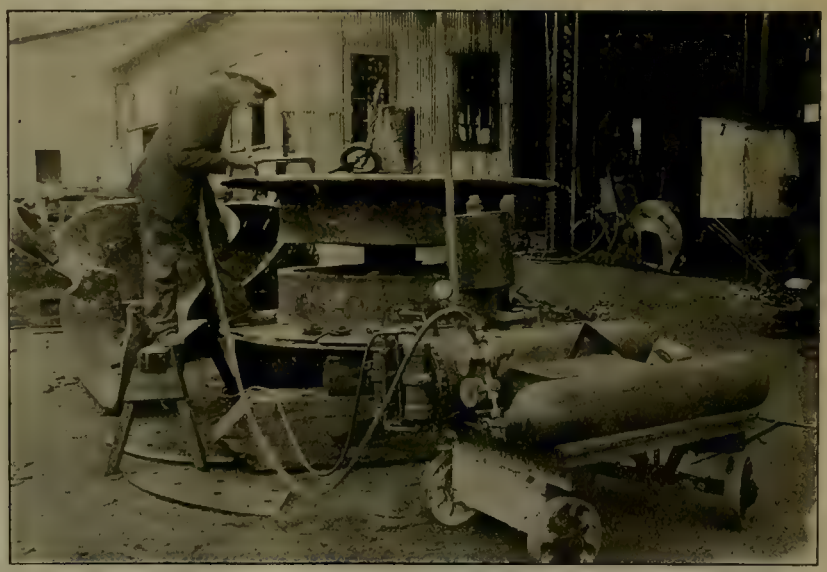


FIG. 7. CUTTING RIVET-HOLES IN A MANGANESE-STEEL TUMBLER WITH AN OXY-ACETYLENE TORCH

FIG. 8. DREDGE WITH LADDER RAISED TO SHOW LOWER TUMBLER

can be riveted in place. These flange sections are of manganese-steel and their shape can be noted from the lower sections which have already been placed in position. The sections are used as templets for determining the positions for the holes to be cut with the torch. The operation of 'drilling' in this manner required but a short time for an entire series of rivet holes around the flange.

The acetylene outfit used about the yard for this purpose is a portable affair which is readily moved from point to point wherever required.

A bucket-idler of large diameter is shown in Fig. 9.

BUCKET WORK. The use of the oxy-acetylene torch is further illustrated in Fig. 10 in connection with work on the buckets. These buckets, made in two pieces, carry a manganese-steel lip which is riveted in position as in the manner shown by the buckets that appear in the background of the picture. When the lips become worn they can be removed readily by applying the torch to the rivet heads. Or again, in fitting up buckets and lips the torch is used as in Fig. 10 for cutting the rivet-holes through the metal.

FIG. 9. A LARGE BUCKET-IDLER

FIG. 10. CUTTING RIVET-HOLES IN A BUCKET WITH A TORCH

Status of the Metal Mining Industry: An Interrogatory—III

LEAD

Question 1: Is lead mining recovering by means of the general lowering of the cost of production?

"Silver and lead mining are recovering, due to lowered cost of production, lower cost of supplies, and a reduction in labor costs, together with more efficient labor."

"Unfortunately, I am not at this moment in close touch with the lead mining situation. I am rather looking on from the side lines, and so do not know as yet whether lead mining is improving or not. So far as concerns those few mines with which I have immediate connection, there has been very little betterment, and yet I feel there is a betterment; and the situation is improving."

"Not yet."

Question 2: What particular factors will influence a return of better prices for lead?

"I hardly imagine we are likely to see very much better prices for lead. My own thought is that we in the United States will have to compete with the people of Europe, particularly the Germans and those people living in old Austria, who produced some of the lead. They are producing at a very low cost in dollars because their own currency is so very much depreciated. For a time we will have to meet that competition, and while the total amount of metal they produce is not very great, it is sufficient to affect the price.

"My thought is that as we have already come back to almost 1913 prices in a large number of articles, we will have to expect that lead too will have to stay at about that pre-war price, and if I remember correctly the pre-war price of lead was somewhere between $4 and $5 a hundred pounds, generally nearer the lower figure. The figures on the following table were taken from the Journal of Commerce of August 23rd and purport to be price indexes as recently compiled by the Harvard Committee on Economic Research:

(Average for 1913 = 100.)

Corn	106	Zinc	73
Wheat	156	Coal	231
Flour	144	Coke	120
Cotton	94	Petroleum	94
Wool	113	Cotton goods	164
Tobacco	78	Silk	162
Sugar	135	Rubber	18
Cattle	99	Hides	71
Hogs	111	Calfskins	90
Pig iron	126	Leather	122
Steel billets	122	Brick	218
Copper	79	Lumber	161
Lead	103		
Tin	62	Average	117

"An organized effort by producers for increased consumption would influence the price of lead for the better."

"Proposed duty to keep out the foreign lead. Increased demand for lead products."

Question 3: What are the lead producers doing individually or collectively to promote the increased use of lead in the arts and crafts?

"Not to my knowledge are producers doing anything, either individually or collectively, to promote the increased use of lead."

"I know of nothing that is being done by lead producers to promote the increased use of lead in the arts and crafts."

"Nothing that I know of."

Question 4: Are the managers of existing properties considering ways and means of reducing operating costs through the installation of more modern and more economical equipment? Please give such particulars as you can.

"At all times alert managers are on the look-out for, and making tests on, more modern and economical equipment with a view of reducing operating costs at all times. By the installation of electric haulage; underground telephones; electric power for hoists and compressors; better ventilation underground; carriages and haulage underground for the use of the men to and from the working places."

"Managers of existing properties have always been considering ways and means of reducing operating costs, and without doubt they are continuing that same program even more strenuously now than ever before."

"Managers of existing properties are considering ways and means of reducing operating cost, but there is no strikingly advantageous or economical equipment that has not already been used."

Question 6: Is there a tendency to substitute mechanical for hand labor wherever possible, and for what particular class of work?

"Yes; replacing hand drilling throughout stopes by air drills; electric haulage; delivery of supplies and tools at convenient places underground."

"There is a tendency everywhere to substitute mechanical for hand labor. This tendency has been increased, due to the high labor cost, and will be still further increased when the cost of well-known mechanical appliances is reduced."

ZINC

Question 1: Is zinc mining recovering by reason of the general lowering of the cost of production?

"I would say 'No' to this question, as with zinc in quantities adequate to meet current demand, selling on the average for say 20% below the bare operating cost of production, the lowering of costs can have practically no bearing on the quantity of zinc produced. The lowering of costs is, however, the only thing that has prevented production at present prices from being absolutely ruinous."

"Up to the present time, so far as we are concerned, there has been no recovery due to the general lowering of the cost of production."

"I do not see any sign at the present time of a recovery, although I believe we will shortly have a recovery. The cost of production has been lowered and is about as low as it can be for the present production. Any increase in production must come from an increased demand and higher prices."

"The zinc properties that are operating today have, as a rule, been successful in reducing their costs from 25% to 50% below what they were a year ago. This reduction has been principally in labor and powder and there are other reductions being made at this time on steel products and other necessary mining repairs and supplies which are helping to gradually reduce costs. The increased efficiency in labor is responsible to a great extent in reducing mining costs. In our case, for instance at ——, our underground efficiency is 100% better than it was a year ago and the men that are working seem to be contented and are putting forth their best efforts to help reduce costs in every direction."

Question 2: What particular factors will influence a return of better prices for zinc?

"The most important factor is the increased consumption of zinc. Consumption at present is only at the rate of approximately 150,000 tons per annum as against a normal rate of 350,000 to 400,000 tons. This improvement will occur in all probability when steel prices become stabilized and output increases again, as about 60% of the zinc output goes into galvanizing. An improvement in the brass industry, and absorption of scrap war brass, would also materially assist, as about 20% ordinarily goes into brass.

"Restriction of zinc output until stocks have been reduced to a reasonable amount, say 30,000-40,000 tons as against actual stocks now of about 95,000 tons, and thereafter adjustment of production to meet consumption."

"Increased consumption with the necessary protection against imports."

"As you know, all metals are at a standstill and this is noted particularly in regard to iron and steel. The world cannot go on without going back in our civilization with the present production and undoubtedly as stocks decrease we will have to go back to a larger production. In zinc the production before the war was about one million tons. The present production is not over four hundred thousand tons. Clearly, unless we are to go back in our civilization, we will have to return to the million tons or more. This can only be brought about by an advance in prices."

"Of course, a general business improvement in all lines will effect zinc but in my opinion the particular factors that would have the most influence on a return of better zinc prices is the increase in manufacture of galvanized sheets and corrugated zinc sheets. On account of inferior galvanizing that was used during the war, it is necessary to a great extent to re-establish our galvanizing trade in foreign countries and at such time as we are again making a first-class sheet and there is any demand for galvanized products, a very large percentage of the domestic production will be consumed through that channel."

Question 3: What has been the effect of the campaign of publicity upon the demand for zinc and zinc production? Has it paid?

"We assume you refer in this connection to the activities of the American Zinc Institute. These efforts have been devoted almost entirely to increasing the uses of sheet zinc, and as we are not producers of sheet zinc, we feel that the answer to this question should come from those who are."

"Not in a position to form an opinion as to whether the campaign of publicity has helped any or not."

"No doubt the campaign of publicity has done good, but it is very clear that the growth of added uses would at best be slow and could not have an immediate effect. When we consider the world's pre-war consumption of one million tons it is quite apparent that none of the new uses suggested could at once be appreciable. No doubt in its broadest sense this publicity has paid, but planting the seed is always expensive and bring no immediate returns."

"I believe that the campaign of publicity for the new uses of zinc has helped. The zinc shingle has been

brought to the attention of the public and I am informed the demand for same is gradually increasing. As soon as there is a revival in building it is my opinion the demand for zinc roofing will be fairly good."

Question 4: Are the managers of existing properties considering ways and means of reducing operating costs through the installation of more modern and more economical equipment? If so, please give such particulars as you can.

"As we are both miners and smelters, we will answer your question from our own standpoint in two parts:

"1.—As regards mining and milling, we believe our equipment is up to date in every respect, and we do not know of any equipment we could install that would be more modern or to any material degree more economical than what we now have.

"2.—As regards smelting, no radical changes are in prospect.

"We do not know whether your question is intended to cover such changes as would amount to the substitution of new processes for old, or whether it refers merely to improvements in existing processes by installation of more modern equipment.

"In the former case, we feel no radical changes are in prospect. Our active smelting equipment consists of two producer-gas-fired retort-plants with sulphuric acid works. We feel that the retort zinc-smelters of the United States, particularly those using coal, have been placed at a great disadvantage over the past few years in comparison with other processes using less labor or less coal than the coal smelter does; but with wages back to pre-war, as apparently they are destined to go, and lower priced coal, which will probably be obtainable upon the negotiation of a new wage contract with the coal miners after March 31st, 1922, it is our belief that the producer-gas-fired-retort zinc-smelters will assert their superiority as of old in the production of zinc from ores that do not contain valuable by-products for the recovery of which the coal zinc-smelter is not well adapted. As the major supply of zinc ore is apparently to come for many years from the Missouri-Oklahoma-Kansas field, and does not contain precious metal values, it is our belief that no 'modern' equipment is likely to take the place of that already available and in use.

"In the latter case, we believe there may be some improvements in roasting through the adaptation of continuous-roasting furnaces, such as the Wedge, to the dead-roasting of zinc ore, which has heretofore had to be performed in Hegeler furnaces, if sulphuric acid was made from the sulphur expelled."

"Believe where there is room for more modern and economical equipment, all managers are giving this necessary consideration."

"No doubt the managers are improving practice, but I have not noticed any radical or sudden changes."

"Account of abundant supply of labor at low prices do not believe there is much attention being given at present to installation of labor saving equipment in mines. There have been installed during the past two years a number of mechanical shovels but inasmuch as now hand shoveling costs less than mechanical shoveling the majority of this equipment is idle.

"During the war there was developed in the —— district one of the richest deposits of zinc that has been known to date and this district is now producing at an operating profit as much zinc as they were producing during normal times in 1912, 1913, and 1914 and selling same at from $20 to $30 per ton. On account of the development of this rich deposit the price of zinc concentrates will no doubt be low over a period of years and with ore at this price the smelting industry would be a profitable game if metal were selling at around 5c."

Question 5: What class of mining, milling, and smelting machinery is least satisfactory in performance of its function, and in what respects should it be improved?

"This question is entirely too broad to be answered briefly."

"This would largely be a local question, although many lines might be suggested."

Question 6: Is there a tendency to substitute mechanical for hand labor wherever possible, and for what particular class of work?

"In mining, as you probably know, the scarcity and inefficiency of labor over the past few years compelled the adoption of mechanical means for loading ore. Since wages have been generally reduced, and labor has again become much more efficient, the mechanical substitutes to quite a large extent have been abandoned. In smelting there is at present no tendency in this direction."

"Think there has always been a tendency to substitute mechanical for hand labor where possible. However, it will be appreciated it has its limitations in mining."

"There are many suggestions, perhaps the most prominent being mechanical haulage and loading, although not much progress is being made in this respect. During the war some progress was made due to high wages more than anything else, but with a lowering of wages the problem does not look as attractive.

"On the whole I do not see much hope, except by the ending of the present stagnation which I believe to be only a matter of a short time. At the present time Joplin is only producing at a rate of less than 150,000 tons of metallic zinc. Wisconsin is practically closed. I am not so familiar with the Western conditions, but I doubt whether all of these including the Eastern fields are producing at the rate of over 25,000 tons and certainly the

whole United States is less than 200,000 tons. Of course, in these figures I have omitted all question of ore raised for oxide purposes, as metallic zinc could not be produced from such ores. Outside of the United States it is not likely at the present time that the production is over 200,000 tons, which would give a total of less than 400,000 tons for the world's supply, as against one million tons in pre-war years. The natural growth of civilization would call for an increasing consumption of zinc. A demand which has a growth from a few thousand tons to a million in 50 years can not drop back to 400,000 tons without a serious derangement of our industries. I see no way of increasing our present production throughout the world without considerable advance in the price of the metal."

Zirconium

On account of various mysterious properties and uses that have been attributed in the popular mind to zirconium, it has at times been styled 'the mystery metal', says the U. S. Bureau of Mines. The compounds of zirconium have numerous important uses, and more doubtless will be found. Investigations have indicated that sintered or coherent zirconium metal is resistive to acids; it can be used for electrodes, and it probably will find a use in metallurgy. A steel-zirconium has been proposed for use in armor plate and automobile parts; nickel-zirconium alloys have been suggested for high-speed cutting-tools and for cutlery. Zirconium oxide is recommended as a refractory, as an abrasive, as a pigment in paints, and as an opaquing agent in enamelware. The salts have been used in the textile industry as a mordant or for the fixing of dye, and also for weighting silk. Zirkite firebrick is used for lining furnaces, as well as for other purposes where a refractory having a low coefficient of expansion, high melting point, and maximum resistance to slag corrosion is demanded. Although zirconium oxide has not proved satisfactory for gas-mantles or for arc-lamps, it has been used for making polishing powders, insulators for both heat and electricity, and in the Nernst lamp. Being non-poisonous, zirconium oxide is finding a use in paints and lacquers, where its resistivity to physical and chemical agents is proving highly valuable. As an abrasive, zirconia, zirconium silicide, and zirconium carbide are suggested for a variety of uses, the carbide particularly as a substitute for the diamond in cutting glass. Zirconium oxide, because of its non-toxic nature, is used in place of bismuth nitrate or carbonate in Röntgen-therapy. It is also said to have medicinal value. Zirconium oxide and nitrate have been suggested for use in the extraction of oxygen and nitrogen from the air. The oxide may find use as a filler in the manufacture of rubber goods. In flash-lights, amorphous zirconium, mixed with certain oxidizing agents, burns with a bright light; but it is doubtful whether the metal would be cheap enough to use in place of the usual material. Coherent white zirconium metal, on account of its acid-resisting properties, has been suggested as a substitute for platinum; its alloys may be used in the manufacture of rust-resisting apparatus. Crucibles prepared from zirconium oxide have been proved superior for high-temperature work to any procurable on the market.

Zircon is found in considerable amounts in many placer deposits derived from disintegration of granitic and pegmatic rocks. The best-known deposits in the United States are near Green River, Henderson county, North Carolina, and in the Wichita mountains, near Cache, Oklahoma. Zircon is found most abundantly in certain syenites of Norway, and occurs in crystalline limestone at Grenville and elsewhere in Canada. Dana states that zircon occurs in various localities in North America, including Litchfield, Maryland; in Essex county, Orange county, and St. Lawrence county, New York; near Reading, Pennsylvania; abundantly in the gold sands of Burke, McDowell, Polk, Rutherford, Henderson, and other counties in North Carolina; with astrophyllite, in the Pikes Peak region in El Paso county, and at Cheyenne mountain, Colorado. In California and elsewhere it occurs in gold-bearing gravels. Baddeleyite (brazilite) is found in large deposits in Sao Paulo, Brazil. This mineral has also been identified in Ceylon, Sweden, Italy, and Montana. Samples of zircon sand from Pablo Beach, Florida, have been investigated, and recently as much as 3% of some of the auriferous sands of Idaho has been found to consist of zircon mixed with monazite. In Brazil, which is an important source of industrial ores, it is difficult, owing to the hardness of the ore, to drill holes for explosives; in handling large amounts resort is had to primitive methods. A large fire is built against an exposed face of the ore and kept burning for several hours, at the end of which time water is thrown upon the ore, which produces fracturing of the mass, permitting it to be sledged into pieces easily handled by one man. Most of the mines are distant from the railroad. Horses for other than saddle purposes are practically unknown, and the ore is transported to the railroad station by ox-carts carrying about one ton each. These carts are of the crudest character, having large, solid, wooden wheels, some 4 ft. in diameter and 6 inches in thickness. From 20 to 30 oxen are generally required for each cart, owing to the mountainous roads. The results of the investigations of the Bureau of Mines are available in Bulletin 186, 'Investigations of Zirconium with Especial Reference to the Metal and Oxide', by J. W. Marden and M. N. Rich.

WORK in the Ivalo gold mines in Finland is to be put on a modern basis, according to a consular report. Steam-shovels and diggers have been ordered from the United States, with which it is intended to shift 500,000 cubic metres of soil per month. In connection with these, a special plant for washing gold will be established, so that nearly all such work will be done by machinery. The Ivalo mining district is between Kultala and Tolonen. Work is being carried on in the Ritakoski district. To facilitate transportation, the construction of 20 km. of road from Purnumukas to Ritakoski is being planned.

Book Reviews

The Editorial: A Study of Effectiveness in Writing. By Leon Nelson Flint. 262 pp. D. Appleton & Co., New York and London. Price, $2.50.

The author is Professor of Journalism in the University of Kansas; the aim of the book is to elucidate "the purposes, possibilities, and methods" of editorial writing, with a view to assisting those who desire to do it well. The first chapter gives a sketch of the growth of this phase of journalism—"the flower of journalism", as the author says. In the United States the golden age of the editorial was the decade before the Civil War, when men like Greeley, Dana, Raymond, Medill, and Watterson indulged in a personal journalism that dominated public opinion. In latter days "the newspaper as a news-gathering and commercial institution has swallowed up the editor as an individual"; newspapers have ceased to be the personal organs of individual editors; "the voice of the great paper has become the voice of an institution". The greater influence of the news columns has led to the "frank mixing of opinion and news, and the more subtle handling of news for editorial effect". Mr. Flint regrets this development and says that "its advantages are bought at too high a price of loss in public confidence". This is a mild criticism. I would say that the tampering with news items is the unpardonable sin; it is to journalism what theft is to a banker, or lying to a clergyman. In the second chapter the weakness and strength of the editorial are analyzed. Sundry charges of weakness and futility are discussed. The one that appeals to me most is the assertion "that editorial columns are seldom used to acknowledge a mistake or to right a wrong". The correction or the withdrawal usually appears in small print in a corner of the paper. Justice demands, of course, that the apology or correction should be given at least as much prominence as the wrong statement. The failure of much editorial writing is imputed to the lack of a knowledge of technique. With this I agree. Few people dare to sing in public until they have learned the technique of singing; a good voice does not suffice, there is an art of vocal utterance that has to be mastered. Not many editors have troubled themselves to learn the technique of their art; it has grown like Topsy, without training or discipline. Some do fairly well if untutored, but even the best could do better if they studied the technique of writing, and the earlier in their career the better. There are right and wrong ways of doing things; the wise man endeavors to ascertain how something can be done in the only way that is worth while—the effective way. As Mr. Flint says: "Even the greatest editors might have been more powerful for a study of the technique of their craft". The editorial gives the newspaper a legitimate opportunity for exercising leadership. It is a mistake to suppose that editorials are not read. This may not apply to the prostituted newspapers of San Francisco, but in other cities, fortunate in the leadership of decent papers, it is true that men and women of the more intelligent kind read the editorials, "and a knowledge of their watchful eyes and alert minds is a constant inspiration to renewed care and labor" on the part of the editor. He is conscious—he must remain ever conscious—of those who "think his thoughts after him". This brings the author to his chapter on the editor and his readers. It is an excellent chapter. As I have said elsewhere, the first rule in writing is to remember the reader; to an editor it is necessary that he should have a knowledge of his following and keep them in mind when he is writing. "If his paper is a small one", says the author, "this is comparatively easy. He need only look up and down the street. If it is a metropolitan paper, he can learn much by personal observation and sometimes through the circulation department". If he does not, it is more than likely that the circulation department will have something to say to him! It is not easy to read the public mind, but it is part of his fitness for his duties that the editor should have the ability to do so, and to do it the first requisite is sympathy. A wide human interest is a pre-requisite to the reading of public thought. If he possess this quality the editor "will early learn not to be misled by the clamor of those who take issue with him on some question. Those who approve are silent; those who disapprove are noisy. It is one of the unhappy features of editorial work that those who like what the editor says rarely tell him so. People have an unfortunate diffidence about expressing appreciation", and, he might have added, an inveterate hankering for dissent. That is not so unfortunate as it seems—apart from the self-esteem of the editor—because it brings to him the letters that are of the most interest to his readers. The average reader does not care to read compliments to the editor; he prefers the protest or objection that comes from the congregation, as it were, for he becomes tired of the pontifical 'we' and enjoys the tilt that calls the gentleman in the pulpit to account for his obiter dicta. Another factor will mitigate the editor's assertiveness, and it is one much less to be desired. The author refers to the selfish interests of the owners of the paper, which thereby come into conflict with the public interest. That, of course, is the milk in the coco-nut (not cocoa-nut). The plain fact stares us in the face that the cost of establishing or of acquiring a great newspaper in these days is so enormous that only the very richest men can afford to go into the business, and of those who have gained wealth the majority have done so by methods inconsistent with high ideals. This at least is certain, that the type of man fitted for editorship is rarely rich enough, or rarely able to make enough money, to acquire the control of the paper with which he is identified; the control rests usually with a politician, a speculator, or a syndicate of rich men. In his subsequent chapters Mr. Flint gives numerous excerpts from editorials, choosing his examples with notable catholicity of taste, and including sundry samples of second-rate stuff, for the purpose of illustration. 'Materials for Editorials' and 'Editorial Purposes' are two chapters in which he gives much useful advice to young men who are ambitious to succeed as editors. In the quotations that he gives to show the methods of some of our best-known papers I find plenty of errors, suggesting that even our best editors write carelessly, probably because they write hurriedly. Unfortunately not much of the editorial writing of the newspapers can claim to be literature, and the cause undoubtedly is the haste that is inseparable from such work. One remark made by the author I like particularly: "Without unduly emphasizing the value of observation, it may be said that the editor of the Chicago newspaper who refused to write an editorial against obstruction of the sidewalk by truck-handlers in the wholesale district until he had gone out and walked around a block or two of obstructions, so as to get a vivid, first-hand knowledge of the evil, was following the right principle". Again he is wise in laying stress on the point that knowledge is not all. Besides knowledge, sincerity of purpose, and technical skill as a writer, it is necessary for an editor to have the experience of life. It is "the determining factor in what the editor really amounts to as a man". He must have a philosophy of life, he must be social, he must be intensely human in his sympathy and outlook. No amount of knowledge fits a man to advise his fellows; the knowledge must be corrected and mellowed by the ups and downs of living, by the vicissitudes that help him to understand the feelings of others by 'going through the mill'. The intelligence tests of the Army failed in this respect; they ascertained that the average enlisted man had the mentality of a child of 13, but they ignored the fact that a man of 43, even if he have the mentality of 13, is greatly the superior of the child by

reason of his experience, which after all is a teacher that none should ignore. Again Mr. Flint refers to the readers as the editor's jury: "The editor who has not discovered his reader is in a position as absurd as that of an orator oblivious of his audience or a statesman indifferent to his constituents". In short, an editorial is not a soliloquy. But when Mr. Flint quotes Arthur Brisbane we are sickened, as when he quotes from the New York 'Evening Journal', to illustrate a vivid style. We feel strongly that a young man, anxious to become a good editor, should first of all recognize Brisbane, Hearst, and the others of the yellow fraternity as the pimps of journalism, as the exponents of all that is meretricious (from the Latin 'meretrix', harlot) in public writing, and that no amount of shallow smartness can condone the rank insincerity and the fundamental ignorance of such men. They represent the one influence that has debased, and is still debasing, American journalism. The omission to recognize this patent fact is the one blemish in a most useful book. I conclude by reproducing the author's quotation from George E. Vincent: "The press is more than a business. It is a social service fundamental to the national life, exerting profound influence upon it. The men of the press must recognize the social nature of their task. If the press be a corporation, it is a public-service corporation with all the responsibility that this implies." And I venture to add that without an honest and intelligent press it is impossible to develop or to maintain the sound public opinion upon which in the last resort depends the welfare of our democratic republic.—T. A. R.

Manual of the Oil and Gas Industry. Compiled by officials of the Treasury Department, U. S. Internal Revenue. 245 pp. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 25 cents.

This manual as originally published in 1919 contained much information that was invaluable to the taxpayer in making out his return and supplying proper valuation data. Since the publication of the original manual, a number of Treasury rulings have been rendered; much additional information regarding the estimation of oil reserves has been collected, studied, and prepared for publication; also a large number of data have been collected and tabulated relating to the number of wells drilled, thus establishing a dry-hole hazard for various districts and fields. On account of the demand for this additional information, the revised manual has been issued to assist the taxpayer of the oil and gas industry to prepare his Federal tax returns correctly and expeditiously. Although endeavor has been made to anticipate all questions that may be asked regarding the law and regulations—and the latter have been amplified when it was deemed necessary to obtain the desired result—it is recognized that such a manual is only general, and cannot cover all information gathered by engineers, geologists, and other technologists, the object being to establish a basis for valuation, depletion, and depreciation in connection with the oil and gas industry. Records of production of thousands of properties scattered throughout all fields in the United States were classified and studied by experienced engineers, with the result that average future production curves and tables are available for almost every producing district in the United States. The book consists of five parts. Part I deals directly with the law and regulations. These, as they relate to the oil and gas industry, have been prepared in accordance with recent Treasury decisions, and are explained by the inclusion of a number of illustrations and examples to bring out their application. Part II deals with the question of depreciation, and should assist the taxpayer in standardizing his classification of equipment. It also offers suggestions as to relative rates of depreciation for different types of physical property. The rates are not to be applied indiscriminately to specific cases, but are relative only; the Treasury Department is in no way committed to accept them in the returns. Part III consists of descriptions and methods of estimating underground oil reserves, especially by means of production curves and tables. The material in this chapter was prepared by W. W. Cutler, U. S. Bureau of Mines, and Roger F. White, Bureau of Internal Revenue. A collection of curves and tables covering many of the pools, districts, and fields in the United States accompanies the text. The curves and tables are intended as a suggestion for the guidance of the taxpayer in the computation of his depletion allowance, which in turn has a direct bearing on the amount of his tax. They are not to be applied indiscriminately to specific properties, and the Treasury Department is in no way committed to accept estimates based upon them. Every claim for deduction on account of depletion must be accompanied by a detailed statement of cost, production, and any other data upon which such claim is based. Part IV contains tables showing, by States, counties, or districts, the number of wells drilled, revealing much information as to initial production, and the percentage of dry wells as compared with productive wells. This chapter was prepared by Albert H. Fay, Chief of the Natural Resources Subdivision, Bureau of Internal Revenue. Part V is a short chapter on the oil industry of Mexico; it contains notes on geology, production, and markets. This chapter was prepared by Oscar H. Reinholt. The investigations leading to the revision of the manual and its publication were made under the general supervision of C. F. Powell, former Chief of the Natural Resources Subdivision. The assembling and editing of the material submitted was done by Mr. Fay. Others who either contributed to, or reviewed the work were Norval White, Chief of the Oil and Gas Section, W. S. Clute, Percy L. Ports, and Burr McWhirt, all of the Oil and Gas Section, Bureau of Internal Revenue, and J. O. Lewis, former Chief Petroleum Technologist, Bureau of Mines.

Working of Steel. By F. H. Colvin and K. A. Juthe. 244 pp., 6 by 9, ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $3.

This treatise contains a practical discussion of the annealing, heat treatment, and hardening of carbon- and alloy-steel. Mr. Colvin is the editor of the 'American Machinist', and Mr. Juthe is the chief engineer for the American Metallurgical Corporation. As they state in the preface, the ever increasing uses of steel in all industries and the necessity of securing the best results with the material used, make a knowledge of the proper working of steel important. It is not the quality of the steel itself or of the alloys used in its composition, but the working or treatment of the steel that determines whether or not the best possible use has been made of it. With this in mind the authors have drawn, not only from their own experience, but from the best sources available, information as to the most approved kinds of steel now in commercial use. These include low-carbon, high-carbon, and alloy-steels of various kinds; the automotive industry has done much to develop new alloys and efficient methods for working them. The practice in Government arsenals on steels used in fire-arms is also given. Although not intended as a treatise on steel-making or metallurgy in any sense, it has seemed best to include information on the making of different steels, and to give a considerable amount of general information to those who desire to become familiar with the most modern methods of working steel. The contents of the book are as follows: I. Steel making. II. Composition and properties of steels. III. Alloys and their effects upon steel. IV. Application of Liberty-engine materials to the automotive industry. V. Forging of steel. VI. Annealing. VII. Case hardening. VIII. Heat treatment of steel. IX. Hardening carbon-steel for tools. X. High-speed steel. XI. Furnaces. XII. Pyrometry and pyrometers.

JUDGE JOHNSON AWARDS UTAH-APEX COMPANY $1,200,000

In his decision on the accounting of damages due Utah-Apex Mining Co. under the verdict awarded the company against the Utah Consolidated Mining Co. last year for illegal extraction of ore, Judge Johnson of U. S. Circuit Court at Salt Lake City finds that the Utah-Apex is entitled to $1,200,000. The Utah Consolidated, in accordance with the original decision of the court, filed an accounting acknowledging that it should pay Utah-Apex some $659,000. The latter appealed this and now the decision awards Utah-Apex $1,200,000.

It is not improbable that Utah-Apex will enter another appeal, for, while this latest award is nearly double the amount of damages Utah Consolidated admitted in its accounting, it is not wholly satisfactory to the former company.

GREAT NORTHERN RAILROAD ISSUES NEW SCHEDULE OF FREIGHT-RATES ON ORES

The Great Northern railway has issued a tariff on ore between all points on its western lines and Bradley, Idaho, where the Bunker Hill smelter is situated. It will become effective on November 21, according to the statement of Frank M. Smith, smelter director for the Bunker Hill & Sullivan Mining & Concentrating Co. The tariff creates freight-rates where none existed. It will make the smelting services of the Bunker Hill available to producers in a wide area on the Great Northern lines. It will open the smelter to the gold, silver, and lead ores of Stevens county, the gold and silver ores of Okanogan county, the gold ore of Republic, all in Washington, and the gold, silver, and lead ores of British Columbia, as well as the silver and lead ores of Troy and Libby, in Montana. The minimum rate is based on ore having a value under $30 per ton. An addition of 25c. per ton is made for each increase of $10 in value up to and over $100 per ton. The O.-W. R. & N. and the Oregon Short Line have established tariffs between points on their lines and the Bunker Hill smelter, but the Northern Pacific has issued no rate except from points in the Coeur d'Alene region and the smelter, according to Mr. Smith.

SECRETARY MELLON OF THE TREASURY DEPARTMENT SEES NO REASON FOR SUBSIDIZING GOLD PRODUCERS

Opposition to a subsidy of any kind to the producers of newly-mined gold was expressed by Secretary Mellon in a letter, dated October 13, to T. L. Oddie, Republican Senator from Nevada, in reply to a resolution signed by twenty-two Western Senators supporting the McFadden bill. The Treasury's position, Secretary Mellon said, had not been altered by developments since May, when he wrote the chairman of the House Ways and Means Committee, declaring the Treasury found no reason for such legislation. Mellon added that there are signs of improvement in general mining conditions, and he believed the abnormal effect of the War would gradually be eradicated without the aid of the gold-production subsidy. The Secretary called attention to the vast accumulation of gold in this country, saying that the United States had the largest gold reserve in its history and the largest stock of monetary gold in the world. He denied that there was a shortage of gold and asserted that "there is nothing in the position of the gold reserve which makes it either necessary or advisable to encourage by subsidies or other artificial means new mine production of gold". Advocates of the measure contend that the proposed measure is not in effect a subsidy. On the contrary, they assert commercial users of gold for several years have enjoyed virtually a subsidy, since they have purchased gold from the Government much lower than the cost of producing it.

OPENINGS FOR METALLURGISTS IN BUREAU OF MINES

Two vacancies for associate metallurgists for the U. S. Bureau of Mines stations at Rolla, Missouri, and at Salt Lake City, Utah, and two for assistant metallurgists at Tucson, Arizona, and at Seattle, Washington, are to be filled by open competitive examinations given under the auspices of the U. S. Civil Service Commission. The salaries for the first position range from $3000 to $3800 per year, and for the second from $2000 to $2800 per year. Applicants for these examinations must qualify in at least one of the following optional subjects:

1. Physical metallurgy. 2. Electrometallurgy. 3. Hydrometallurgy. 4. Lead and zinc metallurgy. 5. Iron and steel metallurgy. 6. Copper metallurgy. 7. Some specialized line of metallurgy not included in any of the above.

Further information may be had by applying at the nearest office of the Civil Service Commission.

ARENTZ NOW OPPOSED TO THE MINING BILL THAT HE INTRODUCED

The following is quoted from the 'Reno Evening Gazette':

"In view of adverse criticism more or less general in mining circles of the State, a substantial share of which is directed unfortunately against S. S. Arentz, Congressman from Nevada, relative to the proposed new mining bill, letters received by friends here from Mr. Arentz within the week, cast timely light on his position in the premises. The language of one letter in particular indicates that Congressman Arentz availed himself of the opportunity to introduce the House resolution at the request of the chairman of the committee on mines and mining for the sole purpose of preventing from doing so some representative who might insist upon its passage and be successful in the operation.

"From the tenor of this correspondence, Congressman Arentz is unalterably opposed to the passage of the measure as it was drafted and he anticipates that it will be 'buried in committee', saying that it will not come before the regular session of Congress if he can prevent it. Congressman Arentz states that he agrees with the views of the prospector and the small mine operator with reference to the bill and it is apparent that the measure will not receive his sanction without radical revision.

"This illustrates pointedly how a representative in Congress must watch his political P's and Q's in the pursuit of his official duties if he expects to continue for long in his

capacity as such. It would seem, from his letter, that Mr. Arentz's purpose in introducing the bill was to keep it out of dangerous hands, his affirmative act in this respect seems to have been designed to accomplish a negative result. It is obvious that he desires to convey to the people of his home State that it is his intention to do what he can to smother the bill rather than to support it. Naturally, Mr. Arentz's political opponents will seize upon this occasion to injure him if they can, for they regard him as an assured candidate for the office of United States senator next year. And in this his friends and enemies are agreed."

COPPER SURPLUS, ON SEPTEMBER 1, ESTIMATED AT 950,000,000 LB., INCLUDING METAL 'IN PROCESS'

The total available supply of copper as of September 1 was 405,051 short tons, equivalent to more than 810,000,000 lb., according to a U. S. Geological Survey report. This did not include working stocks in transit and in process of refining. Estimating the latter around 140,000,000 lb., it would mean that total surplus stocks of crude and refined copper in this country at the beginning of last month approximated 950,000,000 lb. Copper producers say that this may seem a huge amount of metal to be overhanging the market, but they point out that fully half of it is what might be termed a normal surplus of crude and refined copper. They add that with a picking up in demand to anything like the equivalent of the world's actual needs, this surplus would not be a menace to a normal resumption of activity, but would disappear quickly.

Copper sales are running at the rate of approximately 100,000,000 lb. per month. Most of the big mines in this country are closed down, but production from those still in operation, including Miami, Kennecott, Chile, and Cerro de Pasco, coupled with the output from miscellaneous sources, has brought the output up to around 40,000,000 lb. per month.

This would leave around 60,000,000 lb. to be drawn from surplus each month, assuming that monthly sales keep around the 100,000,000-lb. mark, although the industry is sanguine that sales will show a big expansion through the rest of 1921 and most of 1922. At this rate, it would only take eight months to bring the surplus down under 500,000,000 lb., or a normal accumulation of crude and refined metal, including stocks in the hands of manufacturers.

OIL IN BRITISH COLUMBIA

C. O. Stillman, president, and a number of directors of the Imperial Oil Company, were in Victoria, B. C., recently, for the purpose of securing oil-concessions from the Provincial government, it is understood. Stillman stated that his company was disappointed, though not discouraged, at the results so far obtained in Alberta and the Northwest Territories. The company has drills in operation from the international boundary between Alberta and the United States to Fort Norman, and a great deal of money is being expended in exploratory work. The company will continue this work until some definite decision is reached. During the coming winter the company will extend its geological reconnaissance to the Pacific Coast, and if promising geological formations are discovered and satisfactory arrangements can be made boring operations are likely to be commenced in British Columbia next year. At the present time there are 50 men at Fort Norman, and work will be continued throughout the winter, although results have not been particularly encouraging up to date. It is not known what policy the Government will adopt with regard to granting oil-concessions. Two years ago the D'Arcy Development Co., a subsidiary of the Anglo-Persian Oil Co., applied for a concession in the Peace River region, giving it the sole right to explore over an area of 600 miles square, and at the end of five years to select one-tenth of that area, paying the Government a royalty of 12c. per barrel at the casement-head, and undertaking, in the event of commercial discovery, to construct a pipe-line to the coast. The company undertook, too, to spend a considerable amount of money in exploration. This offer was refused, much to the disgust of many prominent mining men in the Province.

MILL TAILING NOT ASSESSABLE AS PERSONAL PROPERTY, ACCORDING TO FEDERAL COURT

According to decision handed down by Federal Judge Tillman D. Johnson, the collection of $158,520 taxes by Salt Lake county from the Utah Copper Co. during the years 1917 and 1918 on tailing dumped near the Magna and Arthur plants at Garfield, was illegal. The county, in assessing the tailing, contended that after the ore was removed from the mine it ceased to be a part of the mining property and was assessable, the same as any other personal property. The Federal court holds that only the net proceeds from the sale or re-treatment of such tailing can be taxed. The complaint was filed by the copper company on April 2, 1919. The taxes amounted to $79,894.50 in 1917 and $78,625.50 in 1918. They were paid on November 30 of each year, under protest, and the company asks for interest at the rate of 8%, in addition to the principal.

AMERICAN MINING CONGRESS CONVENES AT CHICAGO ON OCTOBER 17

The annual convention and exposition of the American Mining Congress opened at Chicago on October 17. The principal object of the convention is to plan for a revival of the mining industry. As a means to this end the Congress is holding, in connection with its convention, a national exposition of mines and mining equipment, in which there will be 207 exhibits of mining machinery and displays of the resources in Mexico, Alaska, California, Utah, Colorado, and other mining States, including the Illinois and the anthracite coalfields and the Lake Superior iron-ore district.

Many of the country's leading business men will attend. Among them will be Charles M. Schwab of the Bethlehem Steel Co., who will speak on 'The Problems of Industry'; Charles Piez, president of the Link Belt Co.; E. M. Herr, president of the Westinghouse Electric & Manufacturing Co.; Edgar F. Smith, president of the American Chemical Society; Senator James A. Reed of Missouri; Governor J. A. O. Preus of Minnesota; Senator S. D. Nicholson of Colorado; Edwin Ludlow, president of the American Institute of Mining and Metallurgical Engineers; Francis S. Peabody of Chicago, who is chairman of the Illinois convention committee; Sidney J. Jennings of the United States Smelting & Refining Co.; Eugene Wolfe, president of the American Zinc Institute; Thomas D'Arcy Brophy of the Anaconda Copper Co.; C. H. Markham, president of the Illinois Central Railroad; George Otis Smith, director of the U. S. Geological Survey; F. C. Honnold, secretary of Illinois Central Operators' Association; C. H. Fulton, Dean of the Missouri School of Mines; H. Foster Bain, Director of the U. S. Bureau of Mines; Luis N. Rubalcaba, Assistant Secretary of Commerce and Industry of the Republic of Mexico. One of the sectional meetings of the convention is a national tax conference. Its object will be to work out means for securing a uniformity of mine-taxation laws in the various States. Another very important conference will be the second national standardization conference.

ALASKA

Anchorage.—The Willow Creek quartz-gold mining district, recently the subject of several news dispatches, some of them reporting sensational strikes, will become a "per-

manent deep mining camp during the coming season", in the opinion of A. H. Brooks, chief of the U. S. Geological Survey, who has just completed a preliminary examination of the locality. Seven stamp-mills have been built to crush high-grade ore. Development of the camp will mean a heavy tonnage for the Government railroad, mining men point out.

ARIZONA

Oatman.—The United Eastern company's No. 3 shaft is 750 ft. deep; a cross-cut will be driven at 800 ft. to the Red Cloud vein, which is proved on Tom Reed ground. The Big Jim shaft is to be developed to the 1000-ft. level; sinking has been started. The tram from the Big Jim to the United Eastern mill will be completed shortly.——The Oatman United company is diamond-drilling to prospect the vein which it now has on the 600-ft. level. The vein is small, but good assays are obtained.——The Alcyone Mining Co. has started diamond-drilling from the 400-ft. level to prospect its ground.

The Oatman Amalgamated company will resume work on November 1 and will continue to cross-cut north to the vein; the shaft is 600 ft. deep.——The United American is sinking a winze on the vein to the 1000-ft. level.——Work has been started on the Henry Ford group on Silver creek. Several other small properties are preparing to work.

CALIFORNIA

Engelmine.—The Engels Copper Co. has driven its new working adit 800 ft. and is advancing at the rate of about 100 ft. per month. The distance to the orebody is 7600 ft., at which point the elevation of the adit will be 490 ft. below the present lowest level.

Forest.—The finding of rich gold ore on the 130-ft. level of the Kate Hardy mine is reported. About a month ago the new mill of the company was started and the new discovery is timely.

Grass Valley.—Rich gold-quartz ore has been found in the Normandie-Dulmine mine on Dead Man's Flat, according to J. C. Gwinn, superintendent. The vein is 2 ft. wide and was entered at the 150-ft. level. The company is financed by Mack Sennett and other motion-picture directors at Los Angeles.

Harbor City.—The re-modeling of the Kirk-Simon smelter is nearing completion. The plant is controlled by the Simon Silver-Lead Co. of Mina, Nevada, and will be used to treat the zinc concentrate made at its new 150-ton mill. New flues have been built, and the furnaces have been remodeled to meet the latest requirements for zinc-oxide manufacture. Improvements also have been made in the bag-house department. M. P. Kirk, who originally built the smelter for the purpose of manufacturing material used in munition plants, is in charge of the reconstruction.

Melones.—According to W. J. Loring, president, more than 1,000,000 tons of ore is blocked-out in the mines of the Carson Hill Gold Mines Co. The average assay he estimates to be $7 per ton. The 30-stamp mill is now operating at full capacity, the stamp-duty exceeding 18 tons per 24 hours.

Sonora.—A number of bonds have been recorded that involve mining property in this vicinity, the aggregate purchase prices being $114,000. The options were obtained by J. E. King, who assigned them through a trustee to the Chilano Gold Mining & Milling Co. The properties are the Chilano, Santissima, Last Chance, Pine Tree, Carrington, Rice, Stockere, and J. A. Gillis claims.

Map of Alaska

Alma.—Lessees of the London M. & M. Co. have made a rich gold discovery on the Hard-to-Beat claim, situated about a mile from the main workings near the head of Mosquito gulch. The vein, 18 in. to 2 ft. wide, samples better than 52 oz. gold and 11 oz. silver. Sorted ore assays as much as $1000 per ton. A car per day is shipped from the main workings, while the London tunnel, now in 2240 ft., is being advanced.——The Louisiana-Colorado Mining Co. has opened new orebodies in its adit; one vein, 2 ft. wide, assays as high as 750 oz. silver and 28% lead. This is on the Dolly Varden property.——Lessees are again operating the Excelsior, a former gold producer on Mt. Bross; the Criterion is also active and producing. These are adjoining properties.

Blackhawk.—The Silver Mt. Mining Co. has two cars of ore from the Black Jack and Wheeler Tunnel veins at the

Leadville smelter. The Black Jack ore is estimated at $100 per ton and the Wheeler tunnel at $65 per ton in gold and silver.

Breckenridge.—The Vulcan Syndicate has let a contract for 2000 ft. of drifting on the adit vein and another contract for the erection of three buildings at Chihuahua for the accommodation of miners.——The Penn mill is operating steadily and has both auto-trucks and teams hauling concentrate to the railroad for shipment to the Leadville smelter.

Central City.—The Polar Star mill is again in operation, treating ores from the Fairfield, Gold Rock, Ella, and Americus mines.

Cripple Creek.—Sinking has been resumed at the Portland company's No. 2 shaft, on Battle mountain. The shaft, now 2450 ft. deep, is to be sunk to 2650 ft. The station will be at an elevation of 7524 ft. and the shaft will then be the deepest in the State.

The Ajax mine now has 25 sets of lessees operating, and daily shipments go to the Independence mill of the Portland company; higher-grade ore goes to the Golden Cycle mill at Colorado Springs.——The Granite company has 12 sets of lessees active, in addition to operations on its own account.

The Mary McKinney Mining Co. has a diamond-drill exploring the main vein at depth. Should results warrant, the main shaft will be deepened.

Lake City.—Ore sampling $37 silver and $70 gold has been opened in the Golconda tunnel, 1000 ft. from the portal and 400 ft. from the surface. A cyanide mill is to be constructed for local treatment and a tramway built to the millsite. The property is in charge of B. C. Essig.

Monte Vista.—Mineral lands of the Baca grant, 12 miles long, extending along the western slope of the Sangre de Cristo range and nearly to the summit, have been secured under 10 years lease by James Allen, mining engineer of Monte Vista. The property will be developed at once.

Ouray.—The Atlas mine, 10 miles west of Ouray, and the mill are operating steadily. Ore from the Mountain Top mine, at an elevation of 12,000 ft., is veing treated. The ore is high-grade, assaying $200 per ton in gold and silver. The company has the largest payroll in Ouray county.

IDAHO

Coeur d'Alene.—The first 60-ton lot of concentrate produced in the mill of the Sunshine Mining Co. has been loaded at Shonts; it will be consigned to the Bunker Hill smelter at Bradley. In addition to the concentrate, the company has 30 tons of high-grade ore on the dump for shipment. The mill is receiving 40 tons of ore daily and producing three tons of concentrate. Jigs and vanners have been installed and the capacity will be increased to 75 tons per day. The hauling of ore from the mill to Shonts is done with a two-ton motor-truck, which makes the round-trip in an hour and a quarter.

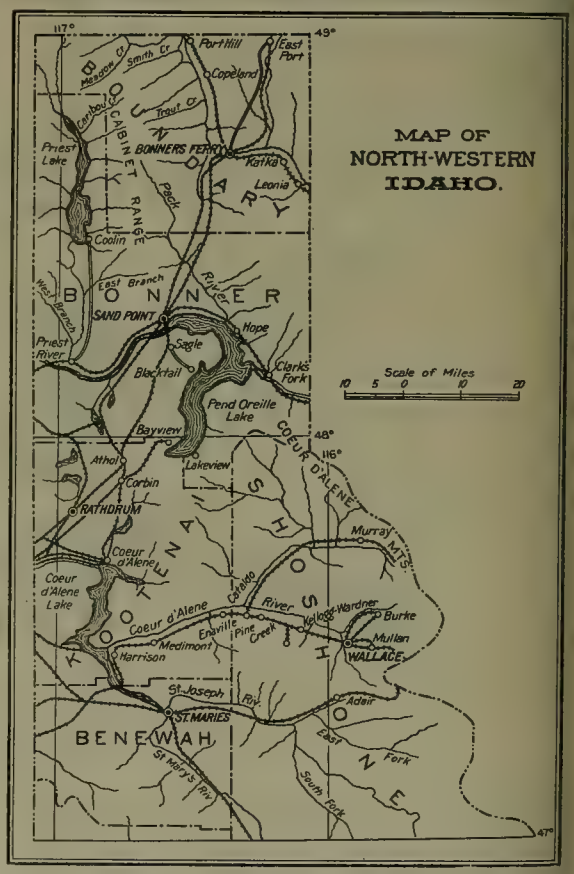
Development is proceeding on the property of the Sterling Silver Mountain Mining Co. A vein was cut in an exploratory tunnel, driven 300 ft., but as work there would attain little depth it was stopped to concentrate effort on the main cross-cut, which is directed toward the second or main vein. Harry Morrel is manager.——Operations on the First National mine have been resumed.——The Blue Bell, between the Sterling and First National, is driving a short cross-cut from the lower level toward the vein.——The development of the Big Hill and Silver Dale, on the west fork of Big creek, is proceeding.

A question as to whether the Nabob Consolidated Mining Co. has two parallel bodies of ore near each other has been revived by the disclosure of a body of rich ore at the surface. The new body contains 4½ ft. of ore and has a lead content of 20%. This lead content is contrasted with a 6% content in the highest stope of the Nabob, said to be within 50 to 100 ft. of the surface.

Mackay.—The Empire Copper Co. has been reorganized under the name of the Idaho Metals Co. The capitalization of the new company is $1,200,000. It is expected that operations will be resumed at the property about November 1. For some time past, the company has been operating principally under the leasing system. L. R. Eccles is president of the new company; Ralph E. Bristol, vice-president; P. B. Porter, C. A. Boyd, and H. V. Jenkins, directors.

MICHIGAN

Houghton.—The report of the mine inspector for Houghton county, for the year ending September 30, shows a total of 3910 men employed in the mines, as compared with 6082



last year and 16,520 in 1916, a normal year. The Keweenaw county inspector's report shows a total of 883 employed in the mines of that county, the majority of them in Mohawk, with 549, and Seneca, with 137. At the Mohawk-Wolverine mill, 122 are on the payroll. The reports reveal the extent of the depression in the copper-mining industry in this district. The only operating mines are Copper Range, Quincy, Mohawk, and Wolverine; Seneca, Mayflower, and Arcadian, the last three being non-producers.

The mining companies of the district, which pay the bulk of the taxes, will benefit by a greatly reduced State tax the coming year. The amount to be raised in Houghton county for State purposes will be $274,576, a decided drop from the present year, when the amount was $383,868. The decrease is due to the fact that Houghton county's equalized valuation was reduced from its former total, while the figures for the State as a whole were increased.

Mayflower-Old Colony is still in material of commercial character in its main south drift from the cross-cut at the 1700-ft. level. For practically its entire distance of 300 ft. it is in good vein-matter, and it holds out the greatest promise of any opening in the property to date. No faulting is in evidence, and the belief is expressed that the best ore will continue to be found in this direction.

Owing to the continued high price of structural steel little construction work is under way in the district, most of the projects contemplated having been pigeon-holed until prices are reduced from present levels. The only important construction is the laying of water-mains from the Tamarack pump-station of the Calumet & Hecla to Ahmeek and from Calumet to the Ahmeek mill. This is more or less of an emergency relief project and is giving employment to between 200 and 300 men part time. About 20 miles of pipe is to be laid, which will supply Ahmeek, Allouez, Centennial, and Keweenaw with water as well as the settlement near the Ahmeek mill. The extension of the water-mains by Calumet & Hecla will permit the draining of wells and effect economies in pumping operations in the subsidiary mines.

The first city in the district to undertake organized relief work as a result of the unemployment situation is Hancock. An unemployment committee has been named and a day set for the registration of all residents of the city out of work. Funds for their relief will be largely raised by voluntary subscription. To help out, the Quincy Mining Co. is preparing to conduct logging operations on its lands near Hancock. Labor is plentiful for this work and the camps to be opened the coming winter will give employment to many idle men of the city and immediate vicinity. The timber will be used for mine purposes.

Calumet & Hecla has made two shipments, of 180,000 lb. each, by rail, to a customer in the Middle West. Both Copper Range and Quincy also have shipped considerable metal so far this month; it went forward by boat.

A total of 312 students have been enrolled at the Michigan College of Mines at Houghton, the largest enrollment in the history of the institution. Seven foreign countries are represented. Nine of the students are from China and one from Siam.

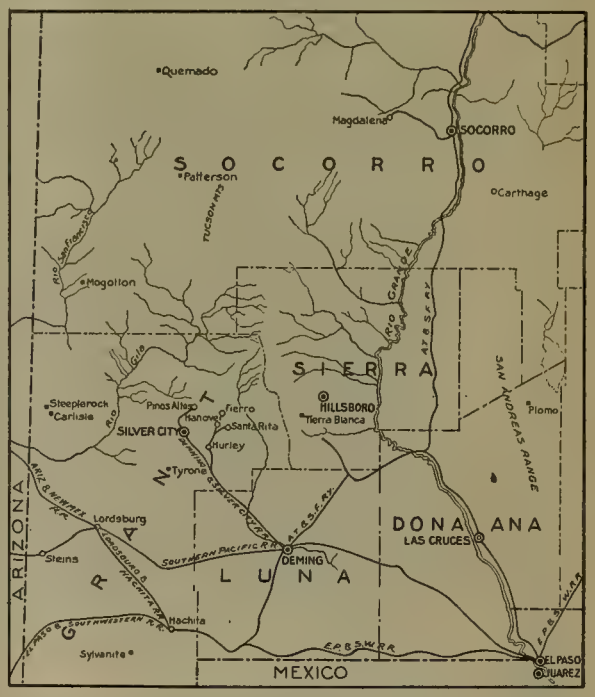
MISSOURI

Joplin.—The strength developed in the zinc market during recent weeks continues, registering a further advance of base prices to a range of $23.50 to $25. Even at the increased offering there was not a notable purchase of ores. The tonnage reported purchased at these figures was 5750 tons of blende or less than the week's output by a considerable tonnage. The strength in the spelter market has caused a marked hardening in the local zinc-ore market. Holders of zinc ore are firm in their demands for higher prices before selling the accumulations of ore in their bins. It will take a considerable advance in prices to secure any large amounts from the strongly held stocks, the tonnages available being from that portion of the regular output each week where the amount of lead ore is not large as a by-product. There is a tendency to increase outputting not only in the starting up of mills long idle but those already in operation are anxious to increase their production while the market shows some signs of going upward. Lead ore was sold generally at $60 per ton for 80% lead, with reports of higher figures unverified.

MONTANA

Butte.—Butte & Superior Mining Co. is in a tax 'muddle' in consequence of the situation arising from the outcome of the recent litigation with the Clark Montana Realty or Elm Orlu Mining Co. Butte & Superior, in its tax return for the fiscal year ending June 30, 1920, listed as an allowable deduction under the Montana statutes, $2,719,379, claiming this was for ores purchased from the Elm Orlu. This amount, in fact, was the total of a judgment amounting to approximately $217,000 for ores and for $2,500,000, which was paid to the Elm Orlu interests in a compromise settlement of litigation then pending.

By including this sum as an allowable deduction the operations of Butte & Superior showed a deficit for the year and the County Board of Equilization appealed to the State Board and, to bring the matter to an issue, sought to claim a tax on the $2,500,000 paid to the Clark people. The Clark people disputed this claim on the ground that the $2,500,000 was not net proceeds on ore but was a payment for peace, being the compromise of the litigation. The Clark people set up that they could not be taxed on the ore in controversy as the suit was compromised, no decision being rendered as to its ownership. As Butte & Superior had been engaged in mining it and had claimed they were the owners of it during the litigation, the Elm Orlu interests could not be held as being the owner of this ore. The amount involved



Map of South-Western New Mexico

on which taxes are asked, so far as the Butte & Superior is concerned, is $1,186,245 and of this amount 4½% is asked as tax payment, amounting to $53,381.

Wise River.—According to John D. Pope, superintendent for the Boston & Montana Development Co., the machinery for the new 300-ton mill is in place and belts are connected ready for operation as soon as the Montana Power Co. completes the transmission line to the mill. At present the active work in the mine comprises drifting west on the Idanha vein on the 450 and 600-ft. levels. In this Idanha vein alone sufficient ore has been uncovered to keep the mill running at full capacity for many months. The company now has more than 300,000 tons of ore awaiting treatment. This ore will run from $15 to $20 per ton in copper, silver, gold, and lead.

NEVADA

Argentite.—F. H. Taylor, manager for the Natural Soda Products Co., which is developing under option the Frances group at Argentite, recently gave the first figures made public on the average length, width, and value of the ore.

Taylor said the 100-ft. shaft is sunk entirely in ore 3 ft. wide and of an average value of $35. The 70-ft. tunnel near this shaft is in ore 6 ft. wide and assaying $12 for the entire length. The 70-ft. tunnel 2500 ft. south of the shaft is entirely in ore 4 to 5 ft. wide and assaying $25 to $50. The Natural Soda Products Co. intends to build a mill if sufficient ore is developed. This company is employing 20 to 25 men, largely in road construction and in putting up buildings.

Ely.—During the period of shut-down 500 fifty-ton cars of ore averaging 8½% copper and containing some gold has been shipped to the smelter and placed in the stock pile by the Nevada Consolidated Mining Co. The development of the high-grade orebody in the Ruth mine from which this ore comes is proceeding.

Hornsilver.—Constantly increasing interest is being shown in Hornsilver and it is expected that in the next two weeks a number of new companies will be organized. Except location work, practically nothing is being done yet outside of the Orlean. Tonopah and Goldfield men have been acquiring ground at reasonable prices for the last month, good claims being bought for $500 to $1500 each, but it is expected that prices will be boosted if ore is found on the 700-ft. level of the Orlean. Sinking of the Orlean shaft has been delayed because of repairs and it still is at the 680-ft. point, not yet in the vein.

The engineer probably most familiar with the district is Edwin S. Giles of Goldfield. He says that the district is promising because of the many places at which ore is exposed on the surface or in old workings. An instance of ore far from the Orlean is the Yellow Metal group, where two prospectors have opened an 18-in. width of $52 ore containing 36.20 oz. silver and 0.80 oz. gold.

Las Vegas.—The Wet End Chemical Co., a subsidiary of West End Consolidated Mining Co. of Tonopah, has 50 men employed in the colemanité mine owned by the company in Clark county 18 miles from the Salt Lake railroad. The deposit is 50 miles from Las Vegas and the shipping point is 12 miles east of there, or 32 miles from the mine. A great deal of road building has been done and the grade has been reduced to a maximum of 7%. The ore will be shipped to the treatment plant at Searles Lake, in California. Colemanite is a hydrous borate of calcium. It is expected that shipments will be started about November 1. Hauling will be done by a 65-hp. tractor with four trailers, which will bring 25 tons daily to the shipping point. A 500-ft. tunnel has been driven at the mine.

Oreana.—The quarterly stockholders' letter just issued by the Pershing County Mines Co. states that the new boarding-house is nearly complete. Seven distinct lenses of silver-lead ore have been disclosed in the course of 200 ft. of drifting on the Jersey vein in property that was recently acquired. The vein will be explored to a depth of 400 ft. Work on the main Montezuma vein is said to be encouraging. Glenn D. Cook is manager.

Reno.—The Reno Chamber of Commerce is arousing the interest of Nevada mine operators in the conference between the carriers and shippers of ore that is to be held before the State public service commission at Carson on November 4. The conference has been called for the purpose of securing lower rates on shipments to Utah and California smelters and, as this involves interstate rates, over which the Nevada commission has no direct jurisdiction, the conference will be held merely in an effort to secure greater co-operation between the producers and the carriers.

The Reno Chamber of Commerce, at a recent meeting attended by 50 men interested in mining, supported a resolution unanimously condemning the proposed mining bill. Although some favored the repeal of the 'apex' provisions of the present law, the general attitude was one of opposition to any changes, on the ground that they were neither necessary nor advisable. Bulkeley Wells, managing director of the Metals Exploration Co., passed through Reno and was quoted as expressing the opinion that if the law "were to be applied to new territory it might be good but applied to old conditions its good effect would be doubtful".

Winnemucca.—The shaft of the Harmony mine will be deepened to the 300-ft. point. The shaft has just been completed at 200 ft., where, according to George D. Williams, manager, a 5-ft. vein of milling ore containing copper, silver, and gold was exposed.

NEW MEXICO

Lordsburg.—The Calumet & Arizona Mining Co. has acquired the famous Norman King and Ballali group of mines in the Steeple Rock district. The properties, which were owned by H. W. Evans and L. C. Butler, were discovered more than 20 years ago. Development work was done on the Ballali group by the Carlisle Development Co. The Norman King mine was held until 1918, when it was opened up by John Christy, who shipped $50,000 worth of ore. It has a 150-ft. shaft, but most of the workings are on the 100-ft. level. Messrs. Evans and Butler took over the property in May, and since then have developed considerable ore, and recently shipped a carload of high grade. A recent assay from a high-grade streak, six inches wide, in the south-east drift, showed 22 oz. gold and 1300 oz. silver per ton.

UTAH

Alta.—The initial shipment of ore from No. 3 raise at the Alta Tunnel property assayed 44.7 oz. silver and 23.3% lead, with small amounts of gold and copper. The ore netted the company $57.15 per ton. In other mines of the district, notably the Emma, the highest-grade ore produced in by-gone days has been found in similar brecciated limestone formation.

American Fork.—Between 40 and 50 men are employed in the construction of the tramway for the Pittsburg mine, according to W. K. Yorston, manager. This mine is about 20 miles from the nearest railway point, and all materials and ore have to be transported by truck for that distance. About 144,000 ft. of cable and 8000 ft. of haulage-rope have been delivered at the mine.

Eureka.—By October 1, the Water Lily shaft at the Chief Consolidated property had reached a depth of 1143 4ft. During September the shaft was sunk a total of 406 ft. By November 1 it is expected that the water-level will be reached, and drifting will then be started.

Owing to the advance in the price of lead, local mines have been increasing production. During the week ending October 8, ore shipments totaled 178 cars, as compared with 144 cars for the preceding week. The Tintic Standard shipped 63 cars; Chief Consolidated, 40; Iron Blossom, 13; Victoria, 12; Eagle & Blue Bell, 11; Iron King, 9; Dragon, 8; Centennial-Eureka, 6; Bullion-Beck, 4; Colorado, 3; Swansea, 2; Gemini, 2; Mammoth, 1; Gold Chain, 1; Alaska, 1; Eureka Hill, 1; Sunbeam, 1.

Park City.—Local mining men are much pleased over the steady improvement in the lead market, and production is being increased as a result. During the week ending October 8, ore shipments totaled 1923 tons, as compared with 1805 tons the previous week. The Silver King Coalition shipped 765 tons; Judge allied companies, 720; Ontario, 393; New Quincy, 45. A shipment of 32½ tons made by the New Quincy Mining Co. from its recent strike gave returns of 55 oz. silver, 18% lead, 1.19% copper, and 42% insoluble, or a gross value of $64.68 per ton. The ore continues to average as high as the initial shipment, and the indications are that the deposit is important.

BRITISH COLUMBIA

New Denver.—Clarence Cunningham has relinquished his option on the Van Roi mine, at Silverton. The Van Roi and the Le Roi No. 2, it is believed, are the only two remaining London-controlled mines out of the big group that was purchased in the early lode-mining boom-days. Cunningham obtained a bond of the Van Roi from its English owners in 1916 for $225,000, and two years later a large sum was paid on the property, the owners agreeing to take the balance of the purchase price in royalties on ore-shipments, with certain provisions as to the minimum quantity of ore to be shipped. Under the option some $350,000 worth of ore has been shipped, and, it is understood, the owning company has received about $150,000. As the Le Roi No. 2 is said to be doing well since the erection of the flotation plant and as Trail is in the market, once again, for silver-lead ore, it is likely that the owner may operate the mine in future. ——Work at the Ivanhoe mill, which was taken over by the Silversmith Mines, Ltd., in the spring, and on the tramway connecting the Silversmith mine with the mill, is nearly completed, and the mill will be put into operation early in November.

Stewart.—Work is being pushed at the Silverton group, in the hope of getting things sufficiently far advanced before the heavy snow comes, and thus guarantee maintenance of operation through the winter. A good trail has been made to the 3000-ft. level, and work is being advanced on the tramway.——Dan and Andy Lindeborg are driving a tunnel in the lode at the Riverside group, which is only seven miles from here, and close to the Premier road. The Lindeborgs report that for 350 ft. the tunnel passed through ore that would average $20 per ton, and that some of the ore would run over $200 per ton. The ore contains silver and gold.——A cable has been received from the president of the Algunican Development Co., who is in Belgium, stating that arrangements have been made to settle up the back debts of the company, and that money was being forwarded for that purpose. The Algunican company did a large amount of development here last spring, at one time employing as many as 150 men. Final payments for labor were not made and some money was owing for haulage.

Trail.—All previous records have been beaten during the first nine months of the present year by the receipt of 307,493 tons of ore and concentrate at the smelter. Close to 98% of this amount has come from the company's own mines. During the first six months of the year the company produced in the neighborhood of 24 million pounds of lead and 26 million pounds of zinc, compared with 26,474,652 lb. lead and 36,995,390 lb. zinc for the whole of last year. The company is said to have an immense stock of zinc on hand, but only about 14 million pounds of lead, or little more than four months supply under normal conditions. Now that the company is in the market for silver-lead ore, output is being curtailed at the Sullivan mine, and a number of men have been laid off. As the Sullivan ore runs about 12% of lead and 18% of zinc, the curtailment of output would seem to indicate that the company is desirous of maintaining its lead output and decreasing the spelter production. The splendid activity of the Consolidated during the depression in the metal market has done much to relieve what otherwise might have been a disastrous unemployment condition in the Kootenays.

ONTARIO

Cobalt.—The La Rose Consolidated is now producing from four mines which are yielding about 130 tons of ore daily. G. C. Bateman, general manager, states that production for the current year will exceed that of any previous year since 1917. The vein recently opened on the Violet is yielding some high-grade ore and a large tonnage of milling rock.——The report of the Bailey Silver Mines for September shows that the earnings of the Bailey mill were approximately $13,389 from the treatment of 4466 tons of ore. There are good prospects for the re-opening of the McKinley-Darragh this fall. Upward of 25,000 tons of broken ore is in the mine ready for treatment.

A Recent Photograph of the Plant of the Tintic Milling Company, at Eureka, Utah

Kirkland Lake.—In opening the 900-ft. level of the Kirkland Lake mine west of the main shaft, the drift, after passing through patchy ground for 150 ft. encountered ore yielding $40 per ton. The mill is treating 135 tons daily with mill-heads of about $9 per ton.

At the Wright-Hargreaves four levels are being developed from the main shaft. The mill is averaging 160 tons per day, the ore averaging $15 per ton. The main shaft will be put down from the 400-ft. to the 800-ft. level with stations for levels at every 100 feet.

The Kirkland Lake Proprietary (1919) has decided to deepen the No. 3 shaft on the Burnside by 70 ft. and make it a central shaft for the operation of the Burnside and the

Tough-Oakes. Two of the Burnside veins have shown exceptionally well under recent development.

The heavy mahinery of the Ontario-Kirkland mill has been installed and it is expected to be ready for operation in six weeks. Preparations are being made for a steady supply of ore. Stopes are being opened on the 300-ft. level. The mill will be able to treat 80 tons per day and it is expected that the recovery will average approximately $15 per ton.

It is reported that Thomas W. Lawson, the Boston financier, will shortly visit the Kirkland Lake gold district to make an inspection of several properties for the purchase of which negotiations have for some time been in progress.

Porcupine.—The new orebody found on the 7th level of the Dome Mines Co., on ground supposed to be valueless, presents great irregularity of outline. It runs upward of 30 ft. in one direction, but otherwise its extent is undetermined. It is a slaty ore, very hard, with a high proportion of calcite, considerable quartz, and in places massive sulphides carrying as much silver as gold. Values average $40 per ton. The orebodies opened on the 1150-ft. level have been proved by diamond-drilling to extend downward for over 200 ft. A raise is being made from the 1300-ft. level, on which development work will be pushed before further sinking. The mill is treating 1000 tons per day with mill-heads averaging $7.50.

Operations have been resumed at the Davidson Consolidated. Lateral work is being carried on at the 600-ft. level and a contract has been let for diamond-drilling at a vertical depth of 1000 feet.

At the Triplex coarse gold began to show in the shaft at a depth of 90 ft. and at 100 ft. the gold content is stated to run $500 per ton. The main dike of the Triplex property extends for 1¼ miles and is half a mile wide with outcroppings which are stated to yield samples that assay $35 per ton in gold.

Though continuous heavy rains have lessened the possibilities of a power shortage, the mining companies are taking no chances. The McIntyre has purchased a large amount of machinery for the installation of an auxiliary power-plant.

Skead Township.—An important ore-zone has been discovered on L. S. 30, one of the properties of the Skead Gold Mines. Eight parallel veins have been found within a width of 225 ft., seven of them showing an average width of 14 in. The eighth vein is 4 ft. wide and has been stripped for a length of 900 ft., and average gold contents as indicated by 66 assays are $29.93 per ton. Eight hundred tons of this ore has been taken out.

South Lorrain.—A new vein has been opened in the lower workings of the Keeley. It is 8 in. wide and shows high-grade ore in the form of smaltite, carrying argentite and wire and leaf silver. The ore in sight is estimated at about a million ounces. Operations will be continued throughout the winter.

Sudbury.—C. V. Corless, general manager for the Mond Nickel company's Canadian operations, who has returned from England, where he was in consultation with the head officials, states that the mining and smelting operations of the company will not be further curtailed.

Swastika.—The Canadian Light Railway Construction Co., which will build a railroad from Swastika to the mining camps east and west of that point, has been reorganized with the following officials: president, C. E. Pinelle; vice-president, Dr. John Noble; managing director, Stephen A. Harnelt; secretary-treasurer, H. J. Kirby. A contract has been let for clearing 100 miles of the right-of-way. The idea of building a narrow-gauge line has been abandoned and an application will be made to the Government for permission to lay standard-gauge tracks.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Laurence Pitblado is in Chile.

L. D. Ricketts is in New York.

B. M. Snyder has gone to southern Mexico.

L. C. Denny has moved from Fresno to Pasadena.

C. A. Richardson, of Cobalt, is on a visit to London.

H. R. Wagner is on his way from Berkeley to New York.

H. D. Bush has left Valdez, Alaska, and is now at Medford, Oregon.

H. B. Tooker, traffic manager for the Jackling companies, is in New York.

P. A. Robbins has moved from San Francisco to Highland Park, Illinois.

G. S. McKay has moved from Cusihuiriachic to Chinipas, Chihuahua, Mexico.

John V. Richards, of Portland, is at Long Beach, California, for the winter.

Morton Webber was recently at Cobalt, Canada, and has returned to New York.

D. W. Brunton motored from Denver to San Francisco; he is now on his way back.

H. R. Palmer, of Long Beach, California, has been examining mines near Prescott, Arizona.

A. E. Flynn has been appointed Professor of Mining in the Technical College of Nova Scotia, at Halifax.

W. H. Goodchild has undertaken a geological examination for the Kirkland Lake Proprietary company, in Ontario.

John A. Burgess is making a geological examination of the Rochester Silver Corporation's property at Rochester, Nevada.

Lionel Lindsay, formerly on the staff of the 'M. & S. P.', will be married in London on October 25 to Miss Yone Kennedy.

M. J. Cavalier, Professor of Metallurgy of the University of Toulouse, is now at Columbia University, as exchange professor.

Solon Spiro, president of the Silver King Consolidated Mining Co., has returned to Salt Lake City after a year's absence in New York.

Glenn Allen, mill superintendent for the Shattuck & Arizona company, has gone to Zacatecas, Mexico, to conduct some metallurgical experiments.

M. W. Hayward is the head of the newly-created geological and exploratory department of the Cia. Minera de Peñoles, a subsidiary of the American Metal Company.

Perry O. Harrison, heretofore consulting engineer to the Portland Gold Mining Co., has been appointed general manager for the company, succeeding **George M. Taylor.**

R. E. Palmer, consulting engineer to the Rio Tinto Company, spent a couple of days in Utah recently, visiting the Utah Copper mine. He is now in Montreal, and will sail shortly for London.

Jesse J. MacDonald, representing James Irving & Co., of Los Angeles, has just returned from a trip to the property of the Trinity Mines Co. in the Turkey Creek district of Yavapai county, Arizona.

Arthur L. Walker, Professor of Metallurgy in Columbia University, attended the Mining Congress meeting at Chicago on October 17, as representative of the Engineering Schools of Columbia University.

Henry H. Armstead has returned to Talache, Idaho, from New York to make an inspection of the construction work of the mill being built at Talache by the General Engineering Co. for the Armstead Mines, Inc.

THE METAL MARKET

METAL PRICES

San Francisco, October 18

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.25
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$82
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.25
Zinc-dust, cents per pound	9.50

EASTERN METAL MARKET

(By wire from New York)

October 17.—Copper is less active and softer. Lead is quiet and firm. Zinc is active and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Oct. 11	72.25	42.50
" 12 Holiday		
" 13	73.25	42.87
" 14	72.75	42.50
" 15	73.00	42.50
" 16 Sunday		
" 17	73.62	42.50

Average week ending	Cents	Pence
Sept. 5	62.50	38.10
" 12	63.96	38.98
" 19	65.14	39.56
" 26	67.68	40.96
Oct. 3	71.07	42.89
" 10	70.73	42.06
" 17	72.97	42.57

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	59.55
Mch.	101.12	125.70	56.08
Apr.	101.12	119.56	59 33
May	107.23	102.69	59 90
June	110.50	90.84	58.51
July	106.36	92.04	59 09
Aug.	111.35	96.23	61.59
Sept.	113.92	93.66	66.22
Oct.	119.10	83.48	....
Nov.	127.57	77.73	....
Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Oct. 11	12.87
" 12 Holiday	
" 13	12.87
" 14	12.75
" 15	12.75
" 16 Sunday	
" 17	12.75

Average week ending	
Sept. 5	11.72
" 12	11.94
" 19	12.08
" 26	12.12
Oct. 3	12.21
" 10	12.64
" 17	12.80

Monthly averages

	1919	1920	1921
Jan.	20.43	19.25	12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	12.74
June	17.53	19.00	12.83
July	20.82	19.00	12.46
Aug.	22.51	19.00	11.71
Sept.	22.10	18.75	12.03
Oct.	21.66	16.53	....
Nov.	20.45	14.63	....
Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Oct. 11	4.70
" 12 Holiday	
" 13	4.70
" 14	4.70
" 15	4.70
" 16 Sunday	
" 17	4.70

Average week ending	
Sept. 5	4.44
" 12	4.55
" 19	4.60
" 26	4.68
Oct. 3	4.70
" 10	4.70
" 17	4.70

Monthly averages

	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.78	4.32
May	5.04	8.55	5.01
June	5.32	8.43	4.57
July	5.53	8.63	4.75
Aug.	5.78	9.03	4.40
Sept.	6.02	8.08	4.61
Oct.	6.40	7.28	....
Nov.	6.76	6.37	....
Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	30.36
May	72.50	54.99	32.50
June	71.83	48.33	29.39
July	70.11	49.29	27.69
Aug.	62.20	47.60	26.35
Sept.	55.79	44.43	26.70
Oct.	54.82	40.47	....
Nov.	54.17	36.97	....
Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date	
Oct. 11	5.10
" 12 Holiday	
" 13	5.12
" 14	5.12
" 15	5.12
" 16 Sunday	
" 17	5.12

Average week ending	
Sept. 5	4.67
" 12	4.70
" 19	4.70
" 26	4.73
Oct. 3	4.94
" 10	4.74
" 17	5.12

Monthly averages

	1919	1920	1921
Jan.	7.44	9.56	5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	6.49	8.76	5.33
May	6.43	8.07	5.37
June	6.91	7.92	4.96
July	7.78	8.18	4.41
Aug.	7.81	8.31	4.69
Sept.	7.57	7.84	4.74
Oct.	7.82	7.50	....
Nov.	8.12	6.78	....
Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	
Sept. 20	47.50
" 27	47.50
Oct. 4	47.50
" 11	47.50
" 18	47.50

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	50.00
June	94.40	85.00	49.50
July	100.00	88.00	47.75
Aug.	103.00	85.00	47.50
Sept.	102.60	75.00	47.50
Oct.	86.00	71.00	....
Nov.	78.00	56.00	....
Dec.	95.00	52.50	....

ELECTRIFICATION OF CHILEAN RAILWAYS

More than passing significance attaches to a contract with the Chilean State Railways in the electrification program involving equipment and other items amounting to approximately $10,000,000. It indicates that despite general depression in most of the world, many countries are willing to do business, if on the right basis. Second, it shows that, contrary to general belief, American firms can actually close business in face of foreign competition if the matter is approached intensively, says the 'Boston News Bureau'.

The $7,000,000 contract for electrification, closed by the Westinghouse Electric International Co. with the Chilean government, is the largest ever undertaken by an American firm outside the United States. The contract was awarded against European and American competition, because of lower price and engineering analysis. Additional contracts are being made with Chilean Railways for 20 freight locomotives from the American Locomotive Co., to cost $1,500,000; 100 steel gondolas from the Pressed Steel Car Co., to cost about $500,000. A contract with the Anaconda Copper Co. amounting to $700,000 is included in the Westinghouse contract. Deliveries of materials and equipment are to start in two or three months, and the entire electrification project is to be completed in 24 months. Payments are to be made in United States gold in New York, and on practically a cash basis, as they are progressive as goods are delivered.

This is the first of four zones to be electrified; the second will be undertaken within five years, and will no doubt mean new contracts for the same firms, as developments in the first zone will determine standards for all. Equipment specified is patented and standardized.

Westinghouse was competing against the great German combination of Siemens & Schuckert together with Allgemeine Elektrische Gesellschaft. Hugo Stinnes is said to be heavily interested in the Siemens & Schuckert concern. Other Europeans competed, including the Swiss, while American competition included a combination of General Electric, W. R. Grace, and Foundation Co.

Westinghouse's bid totaled $6,290,809 in United States gold, plus 2,334,196 pesos Chilean currency ($466,839).

Westinghouse underbid the German combination by approximately $4,000,000, at which the German bid was incomplete. In competition for the contract for steam locomotives, both Germans and Belgians were underbid by Americans. In July, when a contract for 41 locomotives was awarded by the Chinese railroads, Germans were underbid, five of the number going to American Locomotive and 36 to Belgium. Electric locomotives specified in the Chilean contract will cost about $3,800,000. Baldwin Locomotive builds all but the power equipment for the electric locomotives.

MONEY AND EXCHANGE

Foreign quotations on October 18 are as follows:

Sterling, dollars:	Cable	3.93
	Demand	3.93½
Franc, cents:	Cable	7.25
	Demand	7.27
Lira, cents:	Demand	3.94
Mark, cent:		0.62

Eastern Metal Market

New York, October 12.

A strong tone permeates all the markets, particularly copper and zinc.

Demand for copper continues with purchases each day aggregating substantial amounts.

Sales of Straits tin continue in moderate amounts at steady prices.

There is a fair demand for lead at firm prices.

The zinc market is strong with good demand at rising prices.

Antimony continues firm and steady.

IRON AND STEEL

The reduction of 28% in freight-rates on iron ore from both lower Lake ports and the seaboard, effective October 20, means little to the steel trade, says 'The Iron Age', except as it may point to lower freights on coal, coke, and possibly finished materials. While there has been much call from iron and steel producers for lower freights as a stimulant to business, fear is now expressed in the same quarters that buyers may be encouraged by the reduction on ore to wait for similar action on pig-iron and rolled steel and then to look for lower market prices. Producers contend that any saving on freights would merely act to reduce their losses.

The week's figures confirm recent reports of improvement, but to moderate degree. Steel-ingot production in September was 1,174,000 tons for the 30 companies reporting, against 1,138,000 tons in August, an apparent increase of 3%. But counting out Labor Day, the daily rate in September was nearly 10% greater than in August. The Steel Corporation's unfilled orders on September 30 showed the first increase (28,000 tons) in 13 months. But shipments in September on the large bookings of wire and sheets were less than the common estimate.

Japan's activity in rails is noteworthy. A late inquiry covers 5000 tons of heavy sections, following recent buying of 1500 tons of heavy rails and 3400 tons of light rails, the latter divided between British and German mills. In tin plate and sheets Japanese business continues to be a factor.

COPPER

The strength described as pervading the market last week continues and producers are taking every possible advantage of it by selling only a limited quantity at each slight advance in the price. Values have increased nearly each day until electrolytic copper for early delivery (30 days) is quoted at 13.12½c., delivered, or 12.87½c., New York. Some producers are not willing to accept business under 13.25c., delivered, or 13c., New York. Demand continues good with inquiries reported before the market as amounting to several million pounds in addition to the 10,000,000 lb. purchased by the American Brass Co. last week. There has also been a better demand for export with fairly large sales consummated to Germany at a price said to be 13.25c., delivered, Hamburg. On the whole the market is approaching a sellers' market instead of a buyers'.

TIN

Straits tin continues to be sold in moderate quantities each day, but there has been no large activity. Most of that sold was future shipment, largely November-December. Prices have been steady at around 27c., New York, for spot Straits, with futures about ⅛ to ¼c. higher. London prices were £155 15s. for spot standard on Tuesday, £158 5s. for future standard, and £156 5s. per ton for spot Straits. Arrivals thus far this month have been 1580 tons with 3445 tons reported afloat.

LEAD

There has been little change in the past week. A fairly steady demand continues at prevailing quotations, those of the leading producer being 4.70c., New York and St. Louis, with the outside market at 4.50c., St. Louis, and about 4.70 to 4.75c., New York. The market may be described as moderately active and strong at firm prices.

ZINC

Virtually the same conditions obtain in this market now that existed a week ago and these have resulted in higher prices, but the advance has been gradual. Producers continue to sell only their output and not their stocks. Output being under 20% of capacity, and demand having increased, the result is naturally a stiffer market. Prime Western for early or 30-day delivery is quoted at 4.60c., St. Louis, or 5.10c., New York, with some quoting 4.65c., St. Louis, as a minimum.

ANTIMONY

There has been no change in demand or values and the market is featureless and nominal at 5c., New York, duty paid.

ALUMINUM

The principal producer of virgin metal, 98 to 99% pure, continues to quote 24.50c. f.o.b. plant, for wholesale lots for early delivery, with the same grade obtainable from importers at 18 to 19c. per pound, New York, duty paid.

ORES

Tungsten: The market is reported weak because some sellers are anxious to dispose of holdings. Some reports are to the effect that most of the ore is in strong hands, who are 'hanging' on to it pending developments in tariff legislation. Quotations are nominal at $3 per unit and higher, depending on the quantity and grade.

Ferro-tungsten: The market is lifeless and unchanged with the domestic alloy nominal at 40 to 45c. per pound of contained metal and the foreign at 50c. per pound of contained tungsten, duty paid.

Molybdenum: Quotations continue nominal in a lifeless market at 50c. per pound of MoS_2 in regular concentrates.

Manganese: Demand from any source is absent and quotations are nominal at 20c. per unit, seaboard.

Chrome: Quotations are nominal in a quiet market. Ore of 40 to 45% oxide of chromium in the cinder form are held at $20 to $25 per net ton, while higher-grade ore, 45 to 50% Cr_2O_3 is quoted at $24 to $26, both Atlantic ports.

Manganese-Iron Alloys: There is no change in prices, and demand is very light. British ferro-manganese is quoted at $58.35 per ton, seaboard, and domestic producers are meeting this price in regular competition. Very little is heard of any demand for German ferro-manganese, which is quoted at about $53, seaboard. Spiegeleisen is quoted at $25 to $26, furnace, and the market is quiet.

Coal-mine operators expect a boom about January 1, when large consumers stock up as a safeguard against possible difficulties arising from adjustment of a new wage-scale with the United Mine Workers, April 1. With open weather, new and old operations in the coalfields will be able adequately to fill these demands and little trouble is expected in transportation. Orders for shipments in the Connellsville, lower Connellsville, and West Virginia regions have been closed recently at prices as low as $1.40 per ton f.o.b. mines, with almost any amount available spot, at $1.50 per ton.

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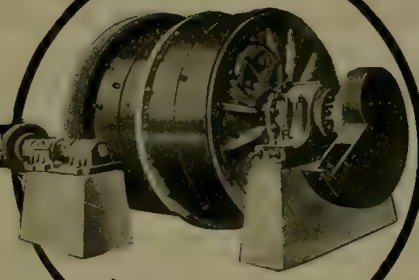

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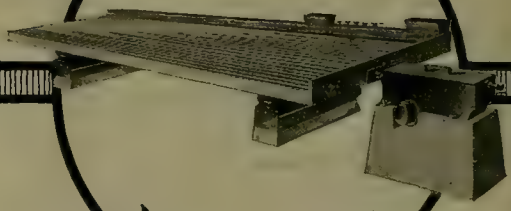

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T. A. RICKARD, ... Editor

W. J. LORING has been re-elected unanimously to the presidency of the American Mining Congress, and his many friends will be delighted to hear of it. The Congress had a successful convention at Chicago.

ONE of the reasons why the price of copper has been so slow in recovering is suggested by the fact that the British government sold all its brass scrap recently to the British Metal Corporation. The purchase price was £4,000,000, which indicates the disposal of a considerable quantity of metal.

LENIN is a humanitarian, says Mr. Washington Vanderlip, in a public address delivered in San Francisco. He has "freed 150,000,000 white people from the toils of a monarchy" and therefore is to be compared, he says, to Abraham Lincoln. We venture to remark that a mining engineer who compares Lenin with Abraham Lincoln desecrates a noble memory and is a person so inaccurate that he might be expected to ignore the difference between a wild-cat and a bonanza, between a fraudulent scheme and an honest enterprise.

MENTION is made in a local newspaper of the fact that a well-known golfer was enabled to play successfully during a fog because, among other things, he rubbed his eye-glasses with a plug of tobacco, imitating a practice recognized among automobilists, who use the same method for keeping their wind-shields clear of moisture when it is raining. Here we have an example of the function of oily matter in lowering the surface-tension of water so as to prevent the wetting of a smooth surface. The oil from the tobacco is smeared over the glass and prevents the water from adhering to its surface.

ALASKA is recovering from the depression caused by the War. At that time the young men, the vigorous prospectors and miners, went into the Army, and the older men "turned their pockets inside out", as one of them phrased it. Moreover, the cost of supplies, always high in such a remote region, became prohibitive. Even at the beginning of the season this year—in May—many declined to buy supplies in preparation for a campaign of work because prices continued to be exorbitant; they preferred to wait until next spring, when we anticipate a real revival. It used to be thought that only alluvial deposits existed in Alaska and the Yukon, but the development of the silver-lead veins of the Mayo and Kantishna districts and of gold veins in the Kuskokwim are so encouraging as to promise the establishment of lode-mining on a considerable scale. Alaska is one of the great mineral regions of the world, and the world will become alive to the fact again soon, as in the days of 1898 and 1899.

REVISED statistics issued by the Director of the Mint show that the production of gold in the United States during the calendar year 1920 amounted to 2,476,166 ounces, valued at $51,186,900, which is a decrease of $9,146,500 as compared with 1919, and $1,677,500 more than the preliminary estimate issued in January. The record output was made in 1915, when this country produced $101,035,700 worth of gold. In 1920 the production of silver was 55,361,573 ounces, valued at $60,801,955; this compares with 56,682,445 ounces, valued at $63,533,652 in 1919. In 1915 the output was 74,961,075 ounces, valued at $37,397,300. The lower value of the larger output suggests how much the miner has benefited from the higher price of the metal.

ON another page of this issue we publish an article, by Mr. D. C. McGruer, on the treatment of the small quantities of impurities, chiefly copper, that exist in the ores purchased by the Sulphide Corporation, for treatment in their smelter at Cockle Creek, in New South Wales. Recently the Corporation decided to refine its own lead bullion, but the copper present in the ores was found to have a marked effect on the efficiency of the Parkes process. The method described in the article to which we refer was then introduced, whereby the objectionable element is removed, and, incidentally, a valuable by-product, bluestone, is produced that contains 99.23% of copper sulphate. This is marketed, and forms an additional source of revenue for the company.

CHARLES E. HUGHES, the Secretary of State, is reported as having made the following remark to a group of appointees to the consular service of the United States: "I confess that, in my experience with young men, the capacity I have found least often is the capacity for accuracy". He is not alone in his experience, unfortunately. In all branches of endeavor, other than in

the study of pure and disinterested science, there is a tendency to underrate the significance of a deviation from veracity, of the camouflaging of facts and figures, or of the cloaking of pertinent details. Such action is futile; it only reflects unfavorably on the doer; it is against common sense to evade the issue in such a manner, and no more important precept than this could be taught in schools, colleges, and universities. It was Thomas Henry Huxley who argued that science is organized common sense. The grandson of that great man, Mr. Julian Huxley, goes further with the definition; science, he says, is not content with the familiar, it is "organized curiosity". Here we see the connection between science and truth; for curiosity infers a desire to acquire facts—the why and the wherefore. Hence a study of science is the best foundation for an education that will be the forerunner of an attitude of impartial veracity throughout life.

DISCUSSION this week starts with a thoughtful letter from Mr. Russell H. Fraser, who writes concerning the prospects facing a recently graduated engineer, like himself. His letter will interest others who are on the threshold of a career, and it will awaken the sympathetic interest of those who can look backward rather than forward. We note that, by implication, he excludes the winning of oil from "the mining industry itself"; this is a common error; the search for oil and the recovery of it belong to mining just as much as the search for and the recovery of metals. The fact that a mineral is found in liquid form does not exclude it from the purpose of mining; sulphur is won in liquid form, sometimes salt and quicksilver; and even gold is mined from some alluvial deposits. However, that is a detail. We agree that the branch of mining devoted to the exploitation of oil-sand is attractive; it receives an assistance from geology that is even more direct than that given to the mining of the metals; it offers many interesting features in the ultimate operations of refining. Our contributor acknowledges that the young graduate in geology can hardly speak as an authority, but he avers that the training of such a graduate is "sufficient to solve many of the practical problems presented by mining". To this we demur, with a kindly smile. Experience underground and an apprenticeship of several years at the mines are needed before anybody is ready to "solve problems" that perplex those who have charge of mining operations. With Mr. Fraser's remarks concerning the many-sided character of oil-shale adventure, we agree; indeed his article is a commencement address by a new graduate, instead of the customary advice from a senior to his juniors; the latter will be more inclined to listen to views that come from one of themselves, for we have noted that young people think most of the advice that comes from a comrade just a little older, not a musty old 'has-been' whose outlook is backward. Another engineer, Mr. Paul R. Cook, discusses technical writing, chiefly for the purpose of protesting against the wordiness of some of the technical articles that he has been compelled to read. We second the plea for conciseness and simplicity; perhaps Mr. Cook will recall the fact that Herbert Spencer made a plea for economy of attention, arguing that the best style was that which involved the least trouble in interpreting the symbols of thought, and so left the reader with the maximum of attention for the thought itself. With the effort to separate the 'practical' from the 'literary' writer, we do not agree; the most practical writer is the one that succeeds best in communicating his ideas, and we have reason to believe that the so-called practical man is less likely to succeed than one who has studied the art of literary expression. However, we support Mr. Cook's motion condemning prolixity. An old friend, formerly in California, Mr. Douglas Waterman, writes from Havana on failures that are due to insufficient working capital; he makes some sensible observations and we hope they may elicit further views on the subject. Mr. Robert B. Brinsmade writes from Mexico on the subject of 'Non-American Issues', which we introduced in a recent editorial. He discusses proportional representation, as a means of circumventing the disproportionate influence of active minorities. Mr. William Motherwell, a metallurgist of wide experience, writes on the use of charcoal as a precipitant in cyanidation, and notes the use of this method at several mills in the Antipodes. Mr. R. van Aubel sends a note from Belgium asking for information concerning indicative plants. The best article on the subject is that by Rossiter W. Raymond in Volume XV of the Transactions of the American Institute of Mining Engineers.

IMPROPERLY ventilated mines are a menace to the health of the workers. An extensive study of the problem has been made by Mr. D. Harrington, of the U. S. Bureau of Mines, and an abstract of a lengthy paper by him appears elsewhere in this issue. In it the author deals with the factors of temperature, humidity, toxic character, and dustiness. It is mentioned that, in many cases, an atmosphere that is so foul that it will not sustain the combustion of a lighted candle is, from the viewpoint of a certain type of mine superintendent, entirely satisfactory. Emphasis is laid on the danger to health from the presence of dust. We learn that the average dust content of the atmosphere in five large mines in the United States was found to be 205 milligrammes per cubic metre. Mr. Harrington compares this with conditions in the Witwatersrand, where the air underground contains on the average, we are told, less than 5 milligrammes per cubic metre. Yes; it is well under 5 milligrammes; for the most recent report of the Standing Committee on Dust Sampling indicates that an analysis of 37,020 samples during 1920 showed an average dust content of exactly 2 milligrammes. Statistics indicate a gradual decrease in the dustiness of the big South African mines since the inception of definite scientific control of the problem. In 1915 the average was 4.9 milligrammes; in 1917 it was 3.8; in 1919, 2.4 milligrammes. It is unfair, however, to make comparison

with the average mine atmosphere in the United States without drawing attention to the fact that, in the Witwatersrand, the efficient control of such problems is simplified because of the contiguity of the properties and because there is a central body—the Transvaal Chamber of Mines—that fosters efficiency and economy by the appointment of working committees and experienced technical staffs; it constitutes a salutary influence in favor of reform in any direction; the recommendations of its special committees are enforced. The results of the systematic effort to allay dust in the mines of the Witwatersrand are chiefly of interest to American engineers as indicating that the misery and inefficiency caused by silicosis and phthisis are preventable.

The Railroad Strike

What may be the status of the railroad strike by the time these pages reach our readers we cannot foresee, but, whatever the event, the subject is one that calls for discussion on account of the principles involved. Such troubles can be obviated or overcome only by the creation of a healthy public opinion; for, in the last resort, it is public opinion that settles such matters under a democratic system. The immediate cause of this industrial crisis is the decision rendered by the U. S. Railroad Labor Board on June 1, which called for a reduction of 12½% in the wages of those working on the railroads. When the decision was made known it was referred to the members of the various unions of railroad employees and they voted in favor of a strike. The action of the leaders in calling a strike on October 30 is said to have been hastened by an intimation that a further reduction in wages was to be expected in due course. The question arises as to the jurisdiction of the Board that announced this reduction in wages. The Labor Board is acting under authority of an Act of Congress and is exercising powers delegated to it by the elected representatives of the people. The labor-unions are wrong in flouting an authority thus constituted; but, unfortunately, a bad example has been set by the other side. The directors of the Pennsylvania Railroad Company had defied the same Board previously, declaring that its action in ordering the election of representatives of employees for the purpose of negotiating with the officials of the company was unlawful. The railroad company refused to deal with anybody not on its own payroll, just as if corporations were not in the habit of engaging lawyers, and others, to represent them in large controversies. For example, Judge Gary is essentially the publicity man of the Steel Corporation; from the point of view of organized labor he is a Lewis or a Stone. In these matters one must be fair. It is curious how little has been said in the daily press about the refusal of organized capital to comply with the ruling of the Labor Board, and how much has been said about the similar refusal on the part of organized labor. Both are in the wrong. The public, however, considers rightly that the action of the labor leaders in threatening a general strike is the worse offence, because it is the more serious in its immediate effects. Any organization within the structure of society as a whole is tolerable only so long as it does not interfere with the public welfare. The threat to cripple the entire system of railroad transportation, in order that a small minority may prevail in an industrial controversy, is an act of sabotage; it is an antisocial act that breaks the fundamental code of civilized life. Under our system no one, not even the Government, can compel a man to work, nor can any man be prevented from ceasing to work. Moreover, we have no satisfactory means for compelling the parties in an industrial quarrel to submit their differences to arbitration, and there exists a strong disinclination to enact laws for this purpose. The experiment has been tried, with questionable success, in Canada and Australia. Even if arbitration were enforceable, there remains the need for enforcing the decision of the arbitrator. The use of military power by the Government for this purpose is repugnant to our people; the average citizen rejects the thought of allowing such coercion. Already the cry of "less government in business, and more business in government" has been raised, and echoed freely. What apparently is needed at this juncture is a benevolent despot, who would cut the Gordian knot promptly and tell both the railroad companies and their employees to behave themselves, and not add to the many troubles from which we are now suffering in consequence of a hideous war. A despot may be useful for a moment, but, to our democratic way of thinking, he is detestable during the remainder of the time; so we shall do the best we can under the deficiencies inseparable from a liberal form of government. As a people we prefer an excess of liberty to a chance of tyranny, and all our constitutional safeguards are framed to this end. Here it is pertinent to recall that our democratic system was insulted in 1916 when the Adamson Act was passed under threat from the so-called Big Four, the leaders of the principal railroad-labor unions. The bulldozing of the Senate by these representatives of labor is responsible for much of the present trouble, for it established a shameful precedent and at the same time fixed working conditions that rendered impracticable the profitable operation of the railroads. As to whether wages are too high or too low, it is difficult to say, because the statistical data offered by the two sides are contradictory; the Labor Board ought to furnish impartial information on this point without delay. In a general way the public understands that the wages of railroad employees were raised during the War and that they ought to be reduced now, in common with other forms of labor and in accord with the decrease in the cost of living. A refusal to discuss the matter of wages or to accept the decision of competent authority, by using the threat of a general strike, leads only to disorder. The railroad companies and the labor-unions alike have been summoned before the Labor Board; the public will insist rightly that both

shall abide by the rulings of an authority established by Congress. The strike is in defiance of the Government and therefore deserves public reprobation, as does the flouting of the Labor Board by the Pennsylvania Railroad Company. The leaders on both sides could be indicted for conspiracy if the charge could be established; but this would prove difficult. Without clear proof of conspiracy nothing can be done to interfere with the legal right of the citizen to quit work. Meanwhile, there is one thing a government can do, and the Government must do, and that is to restrain the parties to the strike from acts of violence or any other interference with the liberty of the citizen and the safety of his property. If the strike must come, and if no better method be available for settling the controversy than this form of industrial duel, then both parties must be held to strict account. The public is keenly irritated by the crass selfishness of the railroads and the unions, and is in no mood to endure any further infraction of the law, especially if it take the form of gun-play. The public is the jury, and in the end its verdict will prevail.

America's Rubber Supply

The race for rubber has ended in the collapse of the participants. The synthetic substitute has been out of the running for some time; in quality and cost of production it failed to meet requirements in Germany during the War. Plantation Para rubber is quoted at under 20 cents per pound; the guayule substitute, previously imported from Mexico, is unprocurable, and its manufacture is little likely to be revived. Rubber is an essential in mining and allied industrial engineering work. Because it can be bought cheaply at the present time is no indication that the subject is undeserving of consideration. History has shown that the cost or the availability of certain essentials in time of peace and in time of war, respectively, are two very different matters. Prior to about 1900, almost the whole of the world's supply of Para rubber, for that is the standard, came from Brazil; but at the beginning of the present century the industry was tottering for a fall. The Monroe Doctrine discountenanced European interest in South America, but it did not prevent the transference of a South American industry to the Eastern tropics; and so it was that in 1876 a load of rubber seeds was cleverly exported from Brazil under the very noses of the authorities; from this beginning have sprung the great rubber plantations in the Orient. Brazil adopted the usual Latin-American tactics, which invariably serve to kill local initiative and industry. Tax after tax was clapped on the rubber leaving the country; in the decade between 1907 and 1917 the exports fell from 68,000 to 53,000 tons. The trees were ruined, and no attempt was made to encourage scientific cultivation. The money obtained from the export-tax was diverted from the industry and was wasted in governmental extravagances. The end was inevitable. In the meantime, with intensive cultivation and scientific control, the output of the transplanted rubber trees, during the same period, rose from about 1000 tons to over 200,000 tons per year. A predominating proportion of this output is now grown in British plantations and in British territory. The United States uses about 80% of the world's supply, and produces almost none. At the present time the supply exceeds the demand. Prices are ridiculously low, and further expansion is improbable as a result of the investment of American capital abroad unless an incentive be offered.

Substitutes came into prominence about 20 years ago, when rubber was selling at a high price. The Germans were ahead in initiative of this kind, for they realized that war might mean isolation from the source of supply; and so it was that intensive research on their part, and also on the part of the British, led to the substitution of a rubber that was made from various materials, including potatoes. However, as with synthetic nitrate, the manufacture of which was also an apparent success, the artificial rubber that was made failed to qualify as an efficient substitute for the natural material, even disregarding the high cost of manufacture. Rubber is a substance that is needed extensively in modern warfare; the insufficiency of a dependable product was felt keenly by the Central Powers in the recent conflict. Great Britain, on the other hand, was able to draw on the supplies from the Eastern tropics for her needs as well as for those of the United States and the other Allies. As with nitrate, the United States had to depend on the good offices of Great Britain for a supply of rubber; there was no shortage, and prices were maintained at a reasonable level. Steps were taken in America to exploit the extraction of guayule, which is obtainable from a shrub that grows in northern Mexico, the cultivation of which had been attempted in Arizona. Although far inferior to Para rubber, this substance found a sale in the United States. It finally ceased to compete against Para rubber, the industry having been discouraged by the export-taxes with which our Latin-American friends obtain so much of their revenue, and was killed finally because of competition with the superior product of the Eastern plantations. The yield of latex from the guayule shrubs under cultivation in the United States is so small that there is little likelihood of the venture becoming a financial success. The present situation with regard to rubber may be epitomized in a few words: the artificial cultivation of the Brazilian rubber tree in the Eastern tropics, away from the tiresome restrictions and export-taxes that discourage industry in so many Latin-American countries, has been amazingly successful; an exceptionally high-grade and clean material is produced at a low cost; the United States uses about 80% of the rubber that is grown throughout the world, and controls only a small proportion of the supply; although the synthesis is of scientific interest, the commercial production of a substitute for Para rubber is as likely as the manufacture of artificial carrots.

The British are often designated a nation of shopkeepers, but it must be admitted that they are willing to do pioneer work in the outposts of the world. Today we

are dependent on foreign nations for a supply of two essentials in peace or war—nitrate and rubber. In peace-time such an arrangement is not undesirable, for economic existence involves buying as well as selling; but complications arise in war-time, and friction develops, as it did between the United States and Great Britain during the Great War. As Dr. Edwin E. Slosson mentions in 'Creative Chemistry', much anxiety was caused in this country during the early period of the War when Great Britain suspected, with justification, that American rubber goods were going to Germany by way of 'neutral' countries. In consequence, Great Britain abruptly shut off our supplies, as she was entitled to do. "This", Dr. Slosson adds, "threatened to kill the fourth largest of our industries, and it was only by the submission of American rubber dealers to the closest supervision and restriction by the British authorities that they were allowed to continue their business. Sir Francis Hopwood, in laying down these regulations, gave emphatic warning that 'in case any manufacturer, importer or dealer came under suspicion, his permits should be immediately revoked. Reinstation will be slow and difficult. The British Government will cancel first and investigate afterward'." Uncle Sam may say that no nation can be aggressive without ample financial backing, and that there can be no more war if the United States will not lend. But other nations also hold trump cards: Chile controls the supply of natural nitrate; Great Britain, the supply of rubber; these commodities cannot be smuggled into the country in sufficient quantities in a few trunks, in the same way that the platinum shortage was relieved during the War. The United States may own a large proportion of all the real money in the world; but a million dollars in gold is of little use to a man who is in the centre of a desert and who wants a drink. What then of the future? Our satisfaction in being able to obtain cheap rubber from British plantations may be short-lived, for the formation of a Rubber Growers Association is being mooted in London, by which the output would be restricted and the price would be controlled in regard to at least two thirds of the rubber-planted areas of the world. Thus it may be that the period of cheap rubber is likely to come to an abrupt conclusion. As with Chilean nitrate since the Armistice, we may have to go without or pay 'through the nose'. The answer to the nitrate problem is expansion at home; we have the resources and the ability. The answer to the rubber problem is expansion abroad; we have the land in the Philippines, although we seem to lack a colonial policy. It takes from five to six years to bring a rubber plantation into bearing, so that the sooner the work is commenced the better. It is stupid to delay because of the present low price of rubber. Plantation rubber has been proved to be a commercial as well as a technical success; there is no hope for a synthetic substitute. Already we have had many bitter experiences in the initiation of industries in Latin-American countries; the Philippines can provide us with a steady supply of a national necessary; thus can we be free from dependence on foreign nations in time of emergency, and from the price-fixing tactics of foreign trusts in time of peace.

Precipitating Copper With Iron

Just now there is a healthy interchange of ideas between exponents of the various branches of metallurgy; it is found that many an excellent piece of apparatus is also applicable, in a modified form perhaps, to perform an alternative task and to work under entirely different operating conditions. The rapid rise of the cyanide process during the earlier years of the present century resulted in the development of much ingenuity in the design of apparatus to meet the varying conditions that prevailed; the problem of treating the refractory slime that so often resulted from the pulverizing of a gold ore claimed much labor and thought. Various devices of intermittent operation were evolved to ensure the isolation of dewatered slime from a pulp of normal fluidity, but the majority were unsatisfactory; continuous personal attention was needed, and chokage was common. Further, an insistent demand arose for a continuous process throughout. Thus it was that, in 1906, Mr. J. V. N. Dorr invented a machine, now so well known throughout the metallurgical world, for the automatic removal of thickened sludge from ore-pulp. This apparatus, since modified and improved to a point that ensures satisfactory service and an almost complete freedom from breakdowns, has found wide application in gold and silver metallurgical plants; it has also been adopted extensively to dewater concentrate, and to prepare, for treatment in filters or driers, various forms of finely divided material in a fluid pulp. In a recent issue Mr. Joseph Irving, Jr., described a novel application of the principle on which the Dorr thickener operates, to that branch of copper metallurgy in which the metal in solution is recovered by scrap-iron. The usual method of treatment is inefficient; the improvement effected by the substitution of the Dorr-Irving system is marked. Not only is the work simplified, but the extraction is higher, and operating costs are lower. An additional advantage, which was not mentioned in the article in question, is seen in the fact that the Dorr vat will take precipitant in almost any shape or dimension; a discarded boiler will serve as readily as will a ton of tin-cans. Consequently, much scrap of large dimension will be available for the purpose and without the added expense of breakage to a size that is necessary in the case of precipitation in launders. More recently, Mr. Irving and his father have been engaged in the development of a heap-leaching process for the treatment of low-grade and mixed copper ores; promising results are being obtained. The copper metallurgists have borrowed and adapted ideas that were developed during the early days of the cyanide process, now seen in the leaching of comparatively coarsely crushed, mixed, dry ore, and in the use of such apparatus as the modern automatic thickener, the mechanical classifier, and the vacuum-filter. However, the time may not be far distant when the tables will be turned, and the cyanide metal-

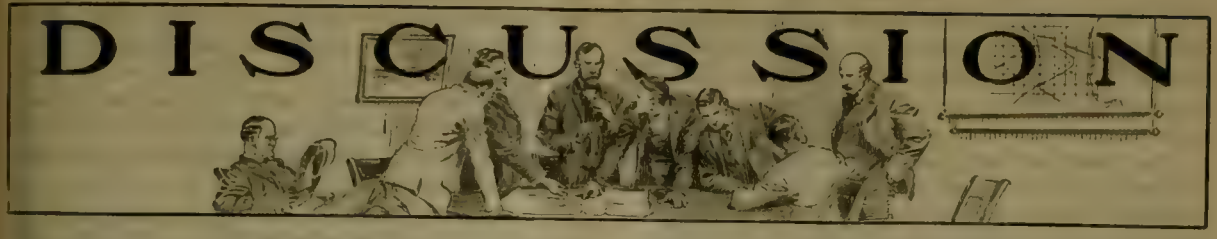
lurgists will be glad to borrow back the original ideas, plus the added improvements that have been made in the preparation of the ore and in the development of large-scale methods, all of which will be of considerable value in connection with the treatment of material from low-grade precious-metal deposits. To the mining engineer, and more particularly to the metallurgist, there is nothing that is ingenious or efficient from the mechanical point of view that is not worthy of attention. Much progress may result from the adaptation of ideas from other industries and as a result of the interchange of ideas between the various departments of our own industry.

Hygiene in the Tropics

Good engineering coupled with faulty hygiene means ultimate disaster in the tropics, as the French found when they attempted to dig a canal across the Isthmus of Panama; many failures in mining can be attributed to the same cause; no enterprise can justify its existence in such places unless adequate provision can be made against the incidence of tropical disease. The work of the health department of the Panama Canal has been persistent since the commencement of operations. Vast expenditures have been made, but the outlay has been repaid in the saving of life and in the general improvement of conditions on the Zone. The annual report, for 1920, is to hand; in it Colonel H. C. Fisher, the chief health officer, gives much interesting and educative information. That prevention is better than cure is an axiom of the first importance with those in control of the health of the residents in tropical settlements. The work of draining swamps in the vicinity of the canal goes on unabated, so that the number and extent of breeding places for mosquitoes have been reduced to insignificant proportions. This, together with the capture of the *anopheles*—as an anti-malarial measure and as an index of distribution—has reduced considerably the prevalence of the disease. It is interesting to note that the open ditch, lined with concrete, has proved unsatisfactory for drainage purposes in the jungle. Many deciduous trees are constantly casting their foliage; the drains become blocked; this leads to the formation of many small collections of still water. Although more easily swept and maintained clean than the earthen ditches, the constant care necessary to prevent mosquitoes from breeding after times of slight rainfall involves danger and expense. Most of the ditches of this type, of which there is about 10,000 feet in the Ancon-Corozal district, are being closed; broken rock and sectional covers are being used for this purpose. Future construction will be with 6- or 8-inch concrete tile, made locally, and covered with broken stone.

The use of quinine as a prophylactic, to prevent malaria, is by no means an ideal method, Colonel Fisher admits; nevertheless, the drug has been instrumental in causing a marked reduction in the number of cases among those from neighboring cattle-camps and plantations. There are better ways of controlling malaria; but the isolation of these camps, their temporary nature, and the fact that the labor is recruited from the infected native population renders advisable the use of quinine. Every day during the first two months of employment each man is given 2½ ounces of an alcoholic solution that contains 10 grains of the sulphate; after the first two months the same dose is prescribed for the morning and evening of each Wednesday, so long as he remains in the camp. This treatment is not compulsory; but it is interesting to note that the incidence to malaria has been lowest in those settlements in which the prescribed measures have been followed closely. For the sterilization of malaria 'carriers', and for the 'follow-up' treatment of ordinary cases, the administration of 10 grains of sulphate of quinine, every evening before retiring and for a period of eight weeks, has been adopted as standard. Results speak well for the efficiency of the medicinal and preventive work of the health department; for instance, the death rate from malarial fever among employees and non-employees in the Canal Zone and among the people of the cities of Panama and Colon, over which it exercises jurisdiction in health matters, has shown a consistent and steady decline. During 1906 it was 9.49 per 1000; during 1920 it was 0.08 per 1000. The recognition of the primary importance of health conservation has been an important factor in the successful engineering work that is associated with the American enterprise on the Isthmus. Those who have an opportunity to study the progress being made in preventive medicine and hygiene there should do so; the health administration in the Canal Zone is doing work of which this country may well be proud.

While on the subject of prophylaxis it is interesting to note that the 'Chamber of Commerce Journal' states that investigations are being made in connection with the medicinal properties of a forest tree that is indigenous to India. One of the civil surgeons of a district in Bengal, having noticed the number of cases of malignant malarial fever, made enquiries among the natives to find whether they used any local plant as a cure. His inquisitiveness was fruitful of result, which recalls the circumstances under which quinine became known, for it appears that there is a tree (*Vitex peduncularis*), found in Chota Nagpur, in Eastern Bengal, and in the Khasia Terai, that contains an unknown drug which may prove to be a valuable addition to the stock of prophylactics for use in the tropics. After adequate treatment of persons suffering from malaria it has been demonstrated, by microscopical examination, that the parasites had disappeared from the blood. The new remedy is said to have several advantages over quinine. It has no bitter taste; it functions as a stimulant, and so may be used by those in delicate health. For mining engineers whose professional work takes them to malarial districts, and who have an unpleasant recollection of the after-effects of the administration of sufficient quinine to avoid or to cure an attack of malaria, the new drug may prove of considerable value.



The Question Confronting the Graduate

The Editor:

Sir—It is natural for one about to enter a new field of activity to seek information regarding it which will enable him to anticipate some of the problems and more pertinent questions that may arise in the course of things. Thus the man about to graduate from college and take up his profession is wont to ask innumerable questions and seek the opinion of those experienced in the particular work he has chosen as to what the future may hold for him. The technical graduate is no exception. Like others who, having completed their college work, are looking over the situation before setting their course, he finds himself at the headwaters of many streams of industrial activity, and wisely hesitates before choosing one or another into which to launch his future. I shall consider the position of the graduate in mining engineering.

Perhaps no broader field is open to any technical graduate than that offered by mining and its allied industries to the untried Engineer of Mines. His college work has prepared him to make a beginning in practically any branch of the industry. If during his college career he has followed a course pertaining to a particular branch of the industry, he may further use his judgment in choosing one or another phase of that branch upon which to concentrate his efforts. It is said that this is the day of specialists. It is undeniable that the opportunities for young men in specialized fields today are far more numerous and attractive than they have been heretofore. The intensity of our industrial development has brought this about. But it is nevertheless true that a broad knowledge of a field is essential to intelligent and successful specialization in it. Herein lies the fallacy of specializing too early. Then too it is unwise for the embryonic engineer to place all his eggs in one basket, for some unforeseen economic force may temporarily remove the demand for his services, leaving him in a state of coma.

Consider the diversity of subjects to which the Engineer of Mines can apply himself: The man who has majored in mining geology has a choice of several fields in which to work. As a member of the geological staff of an oil company he may direct his energies to the determination of oilbearing structures and oilfield development—thus finding a stepping-stone into the petroleum industry; or he may array himself against the geological problems met with in metal mining, coal mining, and quarrying. In recent years, with the feverish search for new oilfields, the man who at college has followed oil-geology has found his services in great demand. The attractiveness of this field has won many undergraduates to the cause of economic geology. With the acceptance of the anticline theory and its practical demonstration, the well-oil industry has developed, in great measure, in proportion to the proving of certain folded areas in oil-bearing strata. However, the ever-growing demand for petroleum, and the fact that a large number of wells have been 'brought in' in areas to which the anticline theory does not apply, urge us to seek an additional hypothesis to that afforded by the anticline theory through which to attack the problem of maximum exploitation of oilbearing strata. Here is a problem for the geologist. His position in the oil industry may rapidly develop into that of production engineer, where the question of maximum recovery replaces that of favorable structure location. The problem of increasing recovery from known oil-pools remains to be solved satisfactorily. Present operating methods recover an average of but 20% of the petroleum content of oilbearing strata. Some of the more successful methods of increasing recovery involve the application of pressure to the oil-sand by means of compressed air or water, pumping, and the removal of wax accretions from the casing by means of live steam or radiation from hot pipes. Various solvents have been used with indifferent success in attempting to re-establish flow in sands clogged with heavy hydrocarbons. The most heroic of these processes, however, has not approached the ideal recovery.

In the rôle of production engineer the geologist will find himself studying the various methods of drilling, the good and bad features of different types of drilling machinery, the applicability of wet and dry drilling to the problem in hand, the human element in his work, the philosophy of the driller's crew, and the economic factors of the work. Although his original duties were of a geological nature, he may eventually find himself installing a pipe-line or erecting a tank-farm, as his apprenticeship in the industry progresses. His work may even remove him from the field to the refinery, with its multitudinous temperatures and cracking processes. The petroleum situation in the United States has reached a point where it is necessary for us to seek additional resources in foreign territory in order to meet the demand for oil at home. At present approximately 20% of the petroleum consumed in the United States is imported from Mexico. American interests in foreign countries require American representation, and the prospects for

young engineers in such organizations are very favorable. The objection may be raised that an engineer engaged in foreign service will be completely out of touch with the industrial conditions at home upon his return. That may be true in many cases, but fortunately perspicacity is not absent from the mental equipment of engineers as a class.

The mining industry itself offers a fertile field to the young geologist. Placer operations may demand his guidance. The successful development of a metal mine may depend upon his judgment. Today, when the mining industry finds itself practically bereft of the old-time prospector, the engineering geologist must take up the task of finding new deposits of valuable minerals. Scientific prospecting is replacing the Forty-niner's methods, and though the new regime will undoubtedly produce greater results, it is doubtful whether the work can be done any more conscientiously. The necessity and the opportunity for research in geological subjects is considerable. True, the graduate in mining geology is far from being an authority on the subject, yet his knowledge is sufficient to solve many of the practical problems presented by mining and its kindred industries. For the solution of the more intricate theoretical problems of geology post-graduate work is a prerequisite to intelligent research.

Although the mining engineer, acting in that capacity, need not be an expert metallurgist, yet the minimum of metallurgical information required of the engineer, in recent years, has increased many times. The mining industry today faces the problem of recovery from ores of a quality found only on the dumps of other years. Hence it has become incumbent upon the engineer to revise his standards of pay-ore and work in closer co-operation with the metallurgist than heretofore. The metallurgist, by the same token, has been forced to revise his more liberal methods for the treatment of high-grade ores and study the economy of vastly inferior orebodies. Improved methods of metallurgical treatment are salvaging the mill-dumps of a few years past. The perfecting of leaching, flotation, magnetic, electro-static, and volatilization processes has proved many of our great deposits of low-grade material to be veritable bonanzas, besides maintaining the country's production of the non-ferrous metals. The new era in metallurgical treatment, particularly in ore-dressing, has practically revolutionized metallurgical machinery. The development of oil-flotation has been materially advanced by the improvements in fine-grinding machinery. The rod-mill is perhaps the latest development in this field. Fine-grinding machinery brought the development of such accessory machinery as slime-tables, vanners, and thickeners, until today our mill-tailings, in the majority of cases, are almost exhausted of valuable mineral. The prospects for the young engineer in metallurgy are indeed bright. With the successful treatment of low-grade deposits of the common metals, the successful treatment of the rare-metal ores is assured. The rare-metal industry is as yet in its infancy, yet such metals as vanadium, tungsten, molybdenum, uranium, columbium, tantalum, thorium, and cerium have created a demand for them on their merits, and will soon cease to be rare. Their industrial application in special steels (as an alloying element) has produced most remarkable and gratifying results. The rare-earth steels are vastly superior to the carbon-steels in strength and toughness, and, in this day when the industrial slogan is 'increased production', their value cannot be overestimated.

The electro-metallurgical industry presents a splendid opportunity to graduates in metallurgy. With the utilization of our water-power resources for the production of electricity, electro-metallurgy has made great strides as an industry in the United States. At the present time this industry is centred about Niagara Falls, from which the essential energy is derived. Norway and Sweden perhaps were the pioneers in the development of electro-metallurgy, and much of our present knowledge of the science has come from them. Electro-metallurgical processes are rapidly replacing many of the earlier methods for the recovery of metals from their ores, manufacture of refractories, chemical reagents, alloys, and the refining of metals. Electro-metallurgy has revolutionized the manufacture of chlorine, sodium hydroxide, aluminum, calcium cyanamide, calcium carbide, and the ferrous and non-ferrous alloys. The electro-metallurgical processes for the refining of the precious and some of the base metals are the most efficient known. The elimination of the smoke nuisance, the recovery of valuable fume from smelter gases, and the removal of water from petroleum products have been accomplished through electro-metallurgical means.

A science that has but recently been recognized industrially is metallography—the study of metals under the microscope. Through its application the physical properties of pure metals and alloys may be determined, and such heat treatment prescribed as will produce a desired result in the internal structure of the material. This is one of the most highly specialized fields in metallurgy, and the graduate would do well to gather experience in pyro-metallurgy and electro-metallurgy before confining himself to metallography.

There is one field of mining to which the young engineer is likely to pay scant attention, and that is the mining of the non-metallics, such as clay, gypsum, sulphur, salt, asbestos, spar, and building-stone. The mining methods used in the recovery of such material are essentially simple, yet there is much room for improvement in the manner in which many of our quarries and clay-pits are operated. The attitude of the quarry-man toward more efficient methods is slightly antagonistic. So long as he is marketing his product at a profit (usually a liberal one), he sees little reason to install a more efficient system of recovery. Here is an opportunity for missionary work. The young engineer is likely to regard the recovery of non-metallics as a less lucrative, not to say less fascinating, occupation than the recovery of metalliferous materials. That is a wrong impression.

Now we shall consider a new child of the mining industry, oil-shale. From present indications it will not

be long before the exploitation of oil-shale will be an industry in itself. Here is a project the development of which demands the intelligence of a broad-gauge engineer, thus exhibiting a goal to which every young engineer should aspire. This field is not confined to the specialist in any one phase of mining. The geologist, oil expert, miner, and metallurgist must each contribute his intelligence to the solution of the oil-shale problem. The geologist must locate and work out the structure of the shale deposits; the miner must remove the shale and get it to the mill economically; the metallurgist, in collaboration with the chemical engineer, must develop and design the roasters and retorts to recover the products of distillation; the oil expert and refiner must produce marketable hydrocarbons from the crude shale-oil. The entire process must be carried out at a cost that will permit the oil-shale product to compete with the well-oil product in the open market. At the present time it is debatable whether oil-shale has won its spurs as an industry. Though it seems inevitable that the exploitation of oil-shale will evolve from the experimental stage into a healthy industry, it has not yet assumed proportions of sufficient commercial magnitude to warrant the apellation 'industry'. At the present time, when capital seems to be taking an interest in oil-shale and extensive experimental work is being carried on, the prospects for the young engineer fortunate enough to find an opening seems very favorable.

I might mention the field afforded the mining engineer by manufacturers of mining and metallurgical machinery. It is obvious that the young man trained as a mining engineer, and possessing a faculty for salesmanship, may find his services of no mean value to producers in this field. 'Constructive selling' is more than a catch-phrase. It is reasonable to believe that such a man, trained in the value of mechanical units and systems, and familiar with mining and metallurgical processes, would be more than an ordinary salesman, and would be received with more welcome and less skepticism by the industry than the man trained merely to sell machinery.

In the early days of mining in the United States it was not difficult to interest capital in mining projects. Unfortunately the capital so readily acquired, in many cases, was quite as easily lost or wasted, till today the question of financial support seems to be the *bête noire* of the industry. The capitalist has ceased to take romance as security; he demands facts and figures, and management. Ultimately, the most important element to a mining engineer's success is his ability to manage a mining property efficiently. There comes a time in his career when the responsibility of spending someone else's money devolves upon him, and by the manner in which he spends it—by the results achieved—shall he be judged. The opportunity to spend another's capital judiciously seldom comes twice. Management is largely a matter of spending and conserving funds, judiciously. The use or abuse of the funds rests upon the engineer's business training and financial acumen, together with his comprehension of the physical factors involved. Hence it is important that the young engineer become not too absorbed in the technical aspects of mining, to the detriment of his economic intelligence.

Many a technical graduate has accepted his first position in some field of endeavor other than that for which he has prepared himself while at college, pending a desirable opening in the field he preferred. After applying himself to his supposedly temporary position for several months, he may find his interests so absorbed that his original aim is forgotten or obscured. Perhaps while working in this position he has married, and the business of meeting new obligations and responsibilities is taxing his resources to such an extent that he hesitates to resume his original course when the opportunity is at hand. Such a state of affairs may or may not be unfortunate. Subsequent developments in his work, which he has ceased to term temporary, may reveal an element of immaturity in his earlier decision, and the young man may be grateful to Chance for so altering his point of view as to present his early choice of fields in its true aspect.

RUSSELL H. FRASER.

Central City, Colorado, October 12.

On Technical Writing

The Editor:

Sir—I was glad to see, in the review of the book by Professor Brewster, of Columbia, on technical writing, a recognition that the supreme purpose of writing is to convey a meaning, and that in some cases errors and poor construction are allowable, when the meaning is thereby more briefly or forcibly conveyed.

There is an occasional gem that is so exquisitely done that it is a pleasure to read it just for the literary charm. However, in most of the reading a mining engineer is required to do, it is a relief to have the author convey his meaning in the fewest possible words, whether or not he obeys or breaks all the rules of writing. Human knowledge has expanded to where it is impossible for one man to know it all. Those who have a real message to deliver are apt to be short on literary style; and those who are long on literary style are apt to be short on message.

The stress that has been laid on literary style, led by the editor of the 'Mining and Scientific Press', one of the exceptional men with both literary style and message, might result in scaring out of technical writing some of the writers of real messages imperfectly delivered, and filling their places with better-written nothings. In many recent cases a one-page message has been expanded into eight pages in literary style which most engineers do not read even when on a subject or job in which they have reason to be particularly interested; so that it is a relief to see a little recognition of the fact that the purpose of language is to convey the meaning in the most direct manner possible, even to the extent of breaking some of the cherished rules of style.

Perhaps co-operation between the practical and the

literary man would be a solution of the problem. Before publication, the practical man should give the effusions of writers possessing literary talent the necessary brevity demanded from an engineering viewpoint; the practical man's message should be subjected to the literary artist, who should be allowed full play whenever he can say as much in as few words.

The fact that few engineers are reading many of the voluminous articles that are handed out today as the literature of the profession is recognized by both the editors of the 'Mining and Scientific Press' and the 'Engineering and Mining Journal', in their criticisms of A. I. M. E. publications. I wonder if they would be surprised to learn how few of their own subscribers ever read some of the lengthy voluntary contributions upon which they themselves have to depend. Many of these articles would be interesting if the author had not expanded a one-page message into eight pages of literature for the prestige he thought it would give him to go into print as the author of a lengthy article.

Conveying the meaning in the fewest possible words is perhaps more important to the profession today than so-called literary style.

PAUL R. COOK.

Rolla, Missouri, October 10.

[We appreciate our correspondent's impatience at the wordiness of some of the articles he finds it necessary to read, and we agree with him that the main purpose of writing is not the expression, but the communication, of ideas. However, the conveyance of thought is rarely effected by writing that is marked by errors of phrasing and by bad construction; on the contrary, the most careful phrasing and the best construction are required for the purpose. Nevertheless, a style that is prolix is not good. We reject many articles that embalm a few ideas in a mass of words, knowing that our readers are too busy to read such stuff. An article that is deficient in literary style but rich in useful ideas is always welcome, and it is our privilege to help the author in conveying his message, by revising his manuscript, not so as to kill its originality but sufficiently to enable him to complete the transfer of his ideas to our readers.—EDITOR.]

Failures Due to Lack of Capital

The Editor:

Sir—From time to time you have sounded a warning in your editorial columns against speculating in shares of mining companies launched by unscrupulous promoters. This is well; it tends to discourage those who prey on public credulity, and at the same time helps those of your readers who are not experienced in mining, to distinguish a legitimate mining report from a flamboyant prospectus.

It is quite common to hear that "as much gold has gone into the ground as ever came out of it". It is true that innumerable mining ventures have proved failures, the sad part being that many of them had merit. The reason for failure was lack of capital. It seems to me that it might be well to warn the layman, the young mining engineer, and even the older engineer, experienced in his profession but not in finance, of the danger of undertaking any mining enterprise without first providing ample funds to carry it to a producing stage, and sustain it during times of depression.

In this respect mining can be compared with commercial enterprises; and it is illuminating to note that in the year 1913, when conditions in the United States were not far from normal, Bradstreet's figures as to the cause of failures show 24% due to lack of capital, while in 1918, 30.8% was due to this cause; the next highest being incompetence. I venture to say that failures in mining due to lack of capital would show a much higher percentage than in industrial enterprises, due to the difficulty of anticipating the requirements.

In times of great inflation in metal prices, people become most interested in mining. Many new enterprises are started; and just about the time they reach the producing stage, or even before, the tide turns and leaves them stranded. At the present time, with copper selling at the lowest price in many years; with huge stocks of the metal awaiting a purchaser, and most of the big producers closed down entirely or running at low capacity, the number of wrecks in this branch of the industry must be very large.

The next important cause of failure in mining is the disregard of our position in the minor or major trade cycle at the time the enterprise is started. Referring to the diagram from 'The Annalist' of July 4, it will be seen that we have completed two major cycles and have entered a third. Commodity prices will probably be on the decline for a long period of years. How will this affect mining? It will certainly be a great benefit to gold mining. The value of the product being fixed, the lowering of costs will continue to add to the profits for many years. This is the time to clean out the old drifts, and get things in shape to take advantage of cheaper money next year. While the present trend of prices is all in favor of gold mining, what would have been the fate of an enterprise initiated seven or eight years ago?

In exploiting the baser metals, we are more concerned with the minor trade cycles. Never in our history have we had such a drastic cut in prices of raw products. On the surface, the prospects for mining of metals other than gold are not cheering, but the reaction will follow as surely as day follows night. The advantage of starting a mine now is that it will have ahead a number of years in which to fortify itself against the next relapse in metal prices; whereas if left until later, full production may not be reached in time to reap the benefits of rising prices.

The criticism may be raised that I am discouraging men of small means from engaging in mining. In a way I am, unless they are associated with mining men with large capital, who may be willing to furnish the best technical advice and the money to see it through.

Mining is an alluring form of speculation, and appeals to many men in and out of the profession. The motive of speculation is profit, but how many who speculate in

mines do obtain a profit? I offer the suggestion to those who care to speculate, that the purchase at this time of shares in mining companies that have a satisfactory record as dividend-payers, is sure to give them a handsome profit within the next two or three years. To show the possibilities of this form of speculation in mining, let us take the record of 20 copper stocks. The average price in September 1907, a panic year, was 28.6; August 1909, 60.8; December 1914, 31.9; November 1916, 66.5; and the average now about 23.5. Copper stocks are certainly bargains today.

If one will rely on averages by distributing widely, buy the shares outright and sell them on the next bull market, he is almost sure of doubling his money, and within the next two or three years.

DOUGLAS WATERMAN.

Havana, Cuba, September 28.

Non-American Issues

The Editor:

Sir—In your issue of September 3, Mr. Crocker deprecates the control of American politics by audacious minorities and proposes a new method of voting for officials, called the Compromise method, as a remedy. By this scheme each voter is required to vote for one more than half of all the candidates nominated for each office with the object of electing one of his own selections. This would undoubtedly elect a candidate of a non-partisan hue—a compromise candidate who would neither be the first love nor the first hate of any voter. Though such compromise selections might be less harmful in office than the agents of unscrupulous minorities, they would be far from ideal. While less likely to be knaves than the officials chosen under the present plurality system, they would be even more likely to be fools. For few candidates of any force of character or aggressive ability could ever get elected by the compromise method, which would constantly tend to elect individuals of so colorless a personality as to be obnoxious to nobody —in other words, nonentities.

A far better method for avoiding the control of politics by non-American minorities, or indeed by any minorities at all, however worthy, is by means of proportional representation, which is designed to make all legislative bodies a miniature, in their political views, of the voters that choose them.* The present system of electing legislatures, by choosing one candidate from each geographic division, has three serious defects: first, the fortunate candidate may have received only a plurality of votes; second, all those who vote against the winner will enjoy no representation in the deliberative body; and third and worst, in any geographic division in which two parties are almost equal in numbers, a small organized minority of independent voters can determine the election by merely throwing its whole vote to either of the two party candidates. This weakness of our representative system has long been known to political students, and accounts for the disproportionate influence on legislatures of such compact minorities as the Grand Army, the Federation of Labor, and the Anti-Saloon League, without mentioning the bodies of hyphenated voters so feared by Mr. Crocker.

The change from the present unfair geographical representation to the equitable proportional system is a simple one, and would undoubtedly have made rapid progress in the United States—as in other leading nations—had it not encountered the opposition of selfish interests, probably the most influential of which are the Democratic political machines of the South, who see no practical way to prevent the election of a large number of negro legislators should proportional representation be adopted.

To establish proportional representation for the election of the Federal congressmen of any State, the first step would be its division into a number of large districts, each electing three or more candidates, to replace the single-member districts now in vogue. Then in a district which had seven Congressmen to elect, and contained 150,000 Republicans, 100,000 Democrats, 50,000 Farmer-Labor, and 50,000 Socialists, the new voting system would ensure the election to Congress of three Republicans, two Democrats, and one each from the Farmer-Labor and Socialist parties. For achieving this accurate proportional result, four principal systems have been devised: the Hare, the List, the Japanese, and the Gore. Of these, the List system is well adapted to party nominations and is a favorite in Europe, being used in Belgium and France. The Japanese is the simplest of all, as a voter has to vote for only one of each group of candidates. Although this system is used for selecting the Japanese congress and is perhaps the best for an ignorant electorate, it has the serious objection that it may result in the winner with the most votes receiving several times more votes than the winner with the least.

All things considered, the Hare system seems the one best adapted to American conditions. It is now being introduced by an active organization,† which has already secured its adoption in the cities of Ashtabula, Ohio, and Sacramento, California, as well as in many smaller electorates. Under this system all a voter has to do is to write as many names on his ballot as there are officials to be elected from his district, and to place opposite each name a number indicating the order of his preference. In counting the vote, there are first declared elected all candidates who receive enough first-choice votes to 'qualify'. If there are five legislators, for example, to be elected from a district in which 50,000 votes are cast, the minimum qualifying number would be 10,000. If insufficient first-choice candidates obtain a sufficient qualifying vote their surplus vote is distributed by fixed rules to second-choice candidates, and so on, until the requisite number of votes is obtained to qualify the required five officials for election.

The proportional principle, of course, applies only to

*'Proportional Representation', by J. H. Humphreys.

†American Proportional Representation League, Franklin Bank Bdg., Philadelphia, Pennsylvania.

the election of representative or policy-determining bodies. Administrative officers obviously should be elected by majority vote, if they are to be chosen at the polls at all. According to views accepted by many political thinkers, chief administrators should all be appointed by the elected representative body and the minor administrators selected by the chiefs under civil-service rules to prevent the interference of political considerations in their appointment. If, however, such officers are elected at the polls, they are better chosen by the application of one of the modern majority systems (using the 'preferential ballot' of the Ware, the Remsen, the Bucklin, or the Nanson variety) that have been successfully employed in Australasia, rather than by our prevailing plurality system.

Not only will the adoption of proportional representation remove the undue influence on politics of organized minorities—even the racial ones so feared by Mr. Crocker—but it will safely permit the extension of government ownership of public utilities in many desirable directions. We had a taste of the danger of government ownership under the present geographic system of electing Congressmen in 1916, when the American Federation of Labor was able to force the Congress to pass the unfair Adamson bill. Whenever the Congress is chosen by proportional representation, the Federation will be unable to dominate more Congressmen than its vote can elect and at present membership that would mean less that 15% of the total House of Representatives.

ROBERT B. BRINSMADE.

Ixmiquilpan, Mexico, October 1.

Charcoal and Cyanidation

The Editor:

Sir—Referring to your editorial on this subject in your issue of October 8, the plant referred to by you as being the first to use this method of precipitation is probably the South German at Maldon, Victoria, Australia, which was controlled by the late W. B. Gray. This method was also in use at the Lake George mines, New South Wales, in 1899-1900. The same Mr. Gray was responsible for its installation there. I do not remember the quantity of solution precipitated daily at the latter plant, but there were 144 tubs such as you describe, and, owing to the silver in the ore, it was necessary to have 6 in each row. The system had all the drawbacks you mention. I have also seen this method in use at the Talisman mine in New Zealand on waste solutions many years ago. In 1915, before I knew anything of the experiments of Messrs. Moore and Edmands, I suggested the use of charcoal dust in Merrill presses to an eminent San Francisco metallurgist, but he said it had been tried and found wanting. It may not be generally known that, for many years prior to 1912, lump charcoal was used to precipitate gold from chlorine solutions at the Mount Morgan gold mine, Queensland, Australia, and, I believe, was found satisfactory. It was placed in square concrete tanks, and I have been told that the gold was visible on the outside of the charcoal lumps, which I have not noticed in using charcoal for cyanide solutions.

While on this subject, it is interesting to recall that in the old days of dry crushing by stamps at the Waihi gold mine, New Zealand, the ore was first dried in vertical kilns in the hillside above the mill, ore and firewood being placed in alternate layers. Naturally there was much charcoal mixed with the ore when it went to the stamps. The whole product was conveyed to shallow leaching-tanks and cyanided, but I never heard of any trouble arising from premature precipitation of gold and silver on charcoal in the leaching-tanks, and the extraction of gold was about 90%. Possibly the fans, which were used to draw off the dust from the stamps, removed most of the charcoal, but even then this dust was collected in bag-houses and probably cyanided, with what result I do not remember. We are all familiar with the trouble from graphite in cyaniding ore at the Ashanti mine in West Africa. Isn't there similar trouble in cyaniding slime in Amador county, California, or has it been overcome?

WILLIAM MOTHERWELL.

San Francisco, October 11.

Indicative Plants

The Editor:

Sir—From early times it has been noted that the soil overlying mineral veins is covered by special vegetation. Can any of your readers give me personal accounts of his experience on the matter?

Correspondents desiring to communicate with me should address their letters as follows:

R. VAN AUBEL,
120 Chaussée de Courtrai,
Gand, Belgium.

September 22.

IT has long been known that on prolonged contact, oils of all types may produce lesions of the skin, affectations which have been described by various observers under different names, states the 'Journal of Industrial Hygiene'. C. G. Page and L. D. Bushnell, who suggest the name of 'oil folliculitis' for the disease, have investigated the bacteriology of oils which are commonly considered to be its cause, and have concluded that the most serious skin diseases are probably due to the oil acting as a carrier of infectious material. To obviate infection, the most important precaution is the exercise of clean habits by the workman. Oils can be sterilized by heating to 70°C. for 20 to 30 minutes, but in practice it is not easy to keep them sterile and free from dust for any extended period. Researches have shown that oils containing ichthyol and those pressed from crude paraffin also produce skin lesions. The addition of germicides to the oils is not satisfactory, but daily filtration and sterilization of the used oils reduce the number of metallic particles present and tend to minimize the danger of bacterial infection.

THE GOLD BULLION MINE AND ITS CLIFF-DWELLINGS

The Gold Bullion Mill and Cyanide Plant, Willow Creek, Alaska

By O. A. Glaeser

INTRODUCTION. One of the most promising regions for the development of small gold-quartz mines in the near future lies in the south-western and south-central part of Alaska, beginning with the well-known Willow Creek district and ending along the northern slope of the Broad Pass region. A number of mines in the Willow Creek district have been steady producers of gold for over ten years, and all indications point to an increase in mining activities in the near future. Since the beginning of construction on the Government railroad that serves these districts, an active interest has been shown in the Broad Pass region. Although prospects are numerous, none have so far developed into producing mines; but sufficient work has been done to show that the region contains a number of well-mineralized areas that are worthy of exploitation.

TRANSPORTATION. Even with railroad facilities, transportation is a problem that will always be a burden to the mine operators. The Alaskan Road Commission is doing all it can to assist by constructing roads; but the work is handicapped by the extremely short summers. The most accessible mines in the Willow Creek district are now reached by road, but many miles of difficult road building must yet be done. The mines are about 25 miles north of Wasilla, the nearest station on the Government railroad. In the past it has been the practice to freight, over the snow, all machinery and supplies that are not affected by low temperature. This is cheaper than bringing them over the road on wagons, or by pack-horse where no roads exist. Transportation practically ceases for a period of about two to three weeks in May, when the snow is too deep for wagons or pack-horses and too soft for sleds.

LABOR. The labor problem is insistent, owing to the fact that employment is seasonal, and also because the old-school miners who were dexterous with the hammer are hard to find. The journey to the district is an expensive one, the working season is short, and living conditions are none too good; a considerable labor turn-over is inevitable during the season. An attempt was made to improve conditions by providing better quarters and better wages. Miners, before the War, were paid $3.50 per day and board. This was increased to $4 per day in 1918; in 1919 a bonus of $1 per day was added, payable at the end of the season. This plan, however, was never strictly followed; men received their bonus on leaving

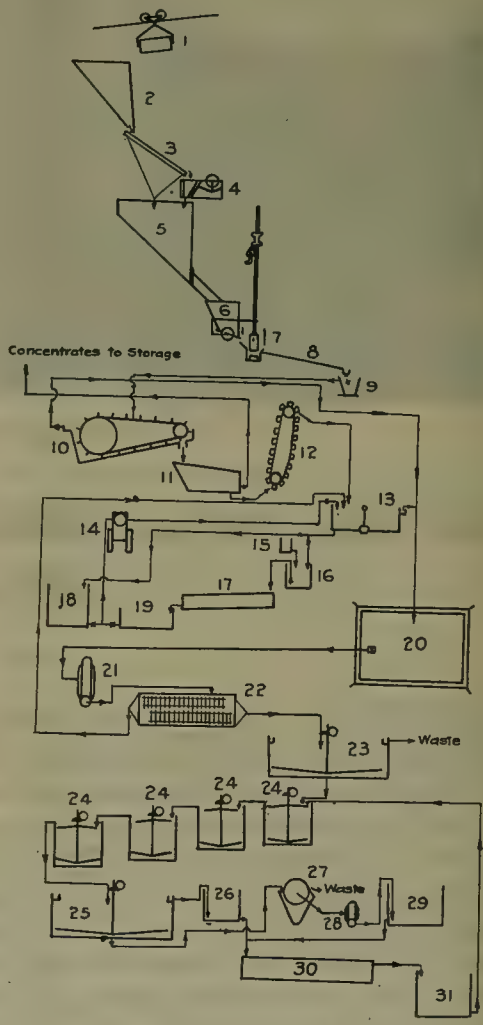
the employ of the company. Moreover, this type of bonus system is not satisfactory. The men do not seem to understand it, and discontent has always been the dominant feature of pay-day. Technical help is excessively expensive. Owing to short-time employment, the salaries of technical men are comparatively high, and all traveling expenses must be met by the company.

Water Supply. Perhaps the biggest problem confronting a mill operator in the district is water supply. The fact that properties have so far only been operated during the summer season is largely due to the scarcity of water for seven months of the year. Up to this year the only source of power for milling purposes has been that derived from creeks. However, one of the operating companies is installing a power plant this year. Whether it will be found feasible to operate during the winter season is doubtful. In the past it has been the practice to open camp early in May, employ a small crew of men, and get all equipment and machinery in shape for the season's run, so that operations can start with the first available supply of water, which is usually plentiful during the months of June and July. If the rainfall is light during these months, a water shortage is sure to come in August, resulting as a rule in a temporary suspense of milling operations, either wholly or in part, for a period of one to three weeks. Once the dry spell is past, steady operation continues until October, when the cold weather cuts off the water supply.

Gold Bullion Mine. The Gold Bullion property is situated near the headwaters of Craigie creek, a tributary of Willow creek, from which the district gets its name. Wasilla, on the Government railroad, is the nearest railroad station; from here a wagon-road leads for 16 miles into the Talkeetna mountains. A 12-mile horse-trail covers the remaining distance to the mill.

The croppings of the Gold Bullion mine are near the summit of the ridge that separates the upper valleys of Craigie and Willow creeks. The mine is at an elevation of 4500 ft.; the mill in the valley has an elevation of 3050 ft., or 1450 ft. below that of the mine. A jig-back tramway, having an hourly capacity of three tons, deliver the ore to the mill. The ore is free-milling gold quartz, occurring as fissure veins in granodiorite. Qualitative tests show the presence of iron, copper, lead, arsenic, and minute quantities of mercury.

Gold Bullion Mill. At the mill the ore is delivered from the rope tramway into a large receiving hopper, then passes over grizzley-bars set to pass 1¾-in. material. The oversize is fed to a 7 by 9-in. Blake-type jaw-crusher. The crushed ore and the undersize grizzley product go to a 150-ton storage-bin. This bin is tapped by three chutes, each of which delivers ore to a Challenge feeder. The mill has a total of 12 stamps, arranged in two batteries of five stamps each and one of two stamps. The two five-stamp batteries are of the front-discharge type; the two-stamp battery discharges its pulp in front and on the sides. The screens used are 30-mesh, standard-gauge wire. The stamps weigh 1000 lb., drop 95 to 105 times per minute, and have a duty of 4 tons per stamp per 24 hours. The pulp passes over amalgamating plates, one for each battery, having a surface area of 4½ by 10 ft. The plates are dressed twice each 24 hours. After passing over the plates, the pulp flows through amalgam-traps to a drag-classifier, where a separation of sand and slime is effected. Spitzkasten classifiers were formerly used, and little attention was paid to good classification, the principal object until recently having been to obtain a sand sufficiently free from slime for treatment in the leaching-plant. The results were that both sand and



FLOW-SHEET—GOLD BULLION MILL AND CYANIDE PLANT

1. Jig-back tramway.
2. Receiving-hopper.
3. Grizzleys.
4. Blake crusher.
5. Storage-bin.
6. Challenge feeders.
7. Stamp-batteries.
8. Amalgamating plates.
9. Amalgam traps.
10. Esperanza drag-classifier.
11. Wilfley concentrating table.
12. Bucket-elevator.
13. Leaching-vats.
14. Solution pump.
15. Sweetener barrel.
16. Distributing barrel.
17. Zinc-boxes.
18. Solution tank.
19. Sump tank.
20. Slime pond.
21. Krogh centrifugal pump.
22. Dorr duplex classifier.
23. Dorr thickener.
24. Agitators.
25. Dorr thickener.
26. Clarifying tank.
27. Oliver filter.
28. Centrifugal pump.
29. Storage tank.
30. Zinc-boxes.
31. Sump tank.

slime were contaminated the one with the other. Screen-sizing tests (see Table I) show that only 68% of the total feed to the leaching-plant is plus 100-mesh. On the other hand, the slime contains about 8% of sand. Closer classification will be attempted hereafter, by producing a cleaner sand in the mill-classifier, and by treating the

SLUICING SLIME

slime with a Dorr duplex drag-classifier before it enters the slime plant.

The sand from the drag-classifier is delivered by launders to a Wilfley concentrating table. The concentrate is stored until sufficient has accumulated for treatment in the cyanide leaching-plant. The table tailing is sent to a bucket-elevator which lifts it to such a height that, with the addition of some water, it will flow in launders to the leaching-vats.

Mill feed and tailing are not sampled for assay. The concentrate from the Wilfley table assays $127.74 per ton.

LEACHING-PLANT. This plant was built six years ago. It consists of five 30-ton and one 35-ton leaching-vats, one 30-ton sump storage tank, one 20-ton solution tank, and two 9-compartment zinc-boxes having a combined capacity of one ton of solution per hour.

Owing to climatic conditions, the cyanide plant must cease operations several weeks before the mill does. The sand from the mill is then sent to settling-ponds, and stored for treatment during the following summer.

The vats are filled either directly from the mill, in which case the sand is sluiced down a wooden launder to the vats, or from the sand pond, from whence it is hauled in a 1200-lb. ore-car, and hoisted up an inclined trestle to a track above the vats where it is dumped. The mill output is sufficient to fill a vat in 20 hours. The overflow water contains a considerable amount of slime. To save this for subsequent treatment it is carried in a launder to the slime-settling ponds. Fourteen hours is required to fill a vat from the sand ponds, requiring the labor of two men. When the vats have been filled with sand they are drained of water; the time consumed is at a maximum in the case of mill sand, about 18 hours. Cyanide solution is then pumped on; the first treatment is with a strong solution containing 5 lb. (NaCN) per ton of solution; the second treatment is a weak solution, 3.5 lb. (NaCN) per ton of solution.

The strong solution is tested for cyanide and it is drawn from the vats; when it shows a cyanide strength of 1 lb. per ton it is turned into the zinc-boxes. Tests have shown that large quantities of water can thus be further drained, which would only dilute the cyanide solution and increase the bulk of it beyond necessary requirements. Treatment lasts about three days, after which the vats are drained of all available solution and the residue is sluiced through a central opening. The tailing is disposed of by letting it run into Craigie creek, which carries it away.

DETAILS OF OPERATION OF LEACHING-PLANT. The ore contains sulphate salts, and a considerable quantity of lime is needed. This is added in two ways; vats filling with pond sand receive about two quarts of a heavy milk of lime with each car of sand, making a total of about 50 lb. of unslaked lime per vat; vats filled from the mill receive when full 72 lb. of unslaked lime in the form of a heavy milk of lime. The difference in the quantities of lime used is due to a natural leaching process that goes on in the sand ponds into which water finds its way continuously. The strong solution constituting the first treatment has a protective alkalinity of 4 lb. per ton of solution, which is brought up to strength by the addition of caustic soda. The cyanide strength is kept up to 5 lb. per ton. It has been found by trial that about 16 tons of strong solution, added as quickly as the sand will take

MILL AND CYANIDE ANNEX, WITH SLIME-POND IN FOREGROUND

it, is the most effective amount to use. This treatment usually takes about 18 hours. The sand is allowed to drain for some hours, after which a weak solution treatment is started. This solution is taken from the sump below the zinc-boxes, and averages about 2.5 lb. protective alkalinity, and 3.5 lb. cyanide. This treatment is as nearly continuous as possible for about 18 hours. The sand is then permitted to drain for 12 hours, when it is sampled for assay and sluiced out. About three hours after the first of the weak solution has been pumped on the sand, the pregnant solution is shut off at the storage, or at the distributing barrel at the head of the zinc-boxes, and turned into the storage tank, where it is standardized for strong solution. This system is used for two reasons: first, to reduce the amount of solution going through the zinc-boxes, and, second, to keep the solution going through the zinc-boxes as high in cyanide as possible. To assist in the latter object a sweetener barrel containing a 1.5% cyanide solution has been placed above the distributing barrel into which the solution drips very slowly. This arrangement has decreased the gold content in the precipitation tailing from 0.05 oz. per ton to 0.02 oz. per ton, or 60%.

Sampling. Two samples are taken of each vat of sand treated. The head sample is taken before any solution is added. The tail sample is taken just before sluicing the sand out of the vat. A representative sample is obtained by the use of a sampling rod, which is made from a ¾-in. pipe 6 ft. long by splitting it along the seam for a distance of 5 ft. The upper end is threaded, and a horizontal cross-arm is attached. Six rod samples constitute one sample that weighs about three pounds.

Zinc-Box Practice. Two zinc-boxes of nine compartments each are used, with a combined capacity of one ton of solution per hour. The boxes are dressed daily, and the zinc is washed every second day. The precipitate is screened on a 40-mesh screen; the undersize is poured into a canvas filter. The precipitate left on the canvas is put into 5-gal. cans and stored for refining. The oversize is short-zinc, and is returned to the zinc-boxes. The direct results of this practice is a high-grade precipitate assaying $51.11 per pound. The filtrate from the canvas filter is piped to the sump tank. At the end of each month the precipitate is weighed and sampled for assay. The moisture content is determined, and the value of the raw precipitate on hand calculated. The precipitate is refined in a small crucible furnace using gasoline as fuel, the bullion assaying about $17 per ounce.

Extraction for the season averaged 71.26%. This is lower than average leaching-plant practice and the reason can be best explained by showing the results of a representative screen-sizing test.

Table I—Screen-Sizing Test on Sand Feed to Cyanide Plant

Assay of sample, $7.23 gold per ton

Mesh	Actual, %	Cumulative, %	Gold content — Per ton	Gold content — %
+ 20	0.4	0.4	$11.58	0.8
30	14.4	14.8	6.20	14.5
40	8.0	21.3	6.20	8.1
80	37.0	59.5	6.20	37.4
100	8.5	68.0	6.20	8.6
150	10.0	77.8	6.20	10.0
200	9.5	87.2	7.86	12.2
−200	6.5	100.0	7.86	8.3

Table II—Screen-Sizing Test on Sand Tailing from Cyanide Plant

Assay of sample, $1.65 gold per ton

Mesh	Actual, %	Cumulative, %	Gold content — Per ton	Gold content — %
+ 30	15.2	15.2	$4.55	26.9
40	7.8	23.0	3.72	11.3
60	35.2	58.3	1.65	22.3
80	13.8	72.2	1.04	5.5
100	9.8	82.0	1.04	3.9
150	11.0	93.0	1.04	4.3
200	2.6	95.0	2.07	21.0
−200	5.0	100.0	2.48	4.7

Table I shows that 21.3% of the total feed to the vat is plus 40-mesh, and contains 23.4% of the total gold; also that 22.2% is minus 100-mesh, which is considered slime. This contains 30.5% of the total gold.

Table II shows that 38.2% of total gold is contained in the plus 40-mesh material and 30% in the minus 100-mesh product.

These figures prove that a higher extraction can be obtained by replacing the 30-mesh screens with those of 40-mesh; and, by closer classification eliminating the slime, which is nearly impervious to the solution, thus obtaining better circulation through the sand.

Cyanide Slime Plant. This plant was built in the spring of 1920. All operations attempted were of an experimental nature. An outline is here given of the method most applicable to the ore with the equipment on hand.

The material to be treated in this plant is an accumulation of slime collected in large ponds for some years. Long and continuous settling has made it very coriaceous and consequently hard to break. This is accomplished with high-pressure water (400-ft. head), using a ¼-in. nozzle in order that a minimum amount of water be used, and the pulp remain as thick as possible. A 3-in. Krogh centrifugal pump lifts the pulp 15 ft. into a Dorr duplex classifier. The sand is sent to the leaching-plant, the overflow to a 34-ft. Dorr thickener. Here the pulp is to be thickened to a 1:1 ratio, but under actual operating conditions it may be found impossible to carry this out in one step without a great reduction in tonnage. An inverted siphon delivers the thickened slime to the first agitator, which is used as a mixer, sufficient barren solution being added to increase the ratio of solution to solids to 2:1. Sufficient slaked lime in the form of a milk is also added to give a protective alkalinity of 1 lb. per ton of solution. The overflow from the first agitator passes into the second, where sufficient cyanide is added to bring the solution up to a strength of 1 lb. per ton. The pulp passes through the third and fourth agitators, is then raised 5 ft. by means of an air-lift and delivered into the loading-well of the second 34-ft. Dorr thickener. The thickened pulp is drawn by gravity to a 12-ft. Oliver filter. The cake is considered waste and drops into Craigie creek. The solution is delivered by a centrifugal pump to the pregnant-solution storage tank. The overflow from the second thickener is elevated 3 ft. by means of an air-lift, and is delivered to a clarifying vat. The gold-solution passes through the zinc-boxes. The barren solution flows by gravity to the barren-solution tank, and thence back to the first agitator. It has been found necessary to throw considerable solution away, as there was an excessive accumulation due to the fact that the pulp

was not thickened sufficiently in the first thickener. This almost doubled the consumption of cyanide. The gold loss, however, is small; precipitation is good, only 0.007 oz. of gold per ton being left in the solution.

Leaching-Plant Operating Costs

Tons treated, 2120

Supplies:	Pounds per ton	Cost per pound, cents	Total cost	Cost per ton	Cost per oz. gold recovered
Cyanide	0.60	32.5	$417.12	0 194	
Caustic soda	1 65	10.5	362.08	0.176	
Lime	1.93	4.25	173.84	0.082	
Zinc shavings	0.48	25 5	261 64	0.123	
Total			$1,214 68	$0 575	
Labor			2,542.22	1.190	
Assaying (labor and supplies)			318 37	0 150	
Refining (labor and supplies)			200.00	0.100	
Total			$4,275.27	$2.015	$8.709

Lime Consumption in Cyanidation

By Ralph W. Perry

High lime consumption in cyanidation is often ascribed to the sulphates, soluble and insoluble, in the ore treated, oxidation products of sulphides being present in most cases, and also being produced to some extent during cyanidation. Lime consumption is usually stated in pounds or kilogrammes per ton of ore, but the grade of lime is seldom specified; this varies, in my experience, from 15% to 75% available CaO (water soluble) so that published figures of lime consumption are of little value except to emphasize the importance of paying attention to the purity of the material used.

A case recently came to my notice in which there was a high lime consumption. Sulphides or sulphates were present in the ore in barely distinguishable quantities, so small in fact that no part of the lime consumption could be attributed to their occurrence, and an investigation showed that ferrous carbonate was present in appreciable amounts and was being oxidized during the treatment to ferric hydrate or possibly to hydrated ferric oxide. This oxidation was accompanied by a corresponding precipitation of calcium carbonate if lime was present in sufficient quantities, the iron otherwise combining with the cyanide to form sodium ferrocyanide.

In the absence of lime the ferrous carbonate apparently reacts in a manner similar to ferrous sulphate, but, being an insoluble salt, the reaction proceeds much slower, according to the following equation:

$$FeCO_3 + 6NaCN = Na_4Fe(CN)_6 + Na_2CO_3$$

The formation of sodium carbonate was proved in tests in which caustic soda was used instead of lime. In the presence of lime the probable reaction is:

$$2FeCO_3 + 2Ca(OH)_2 + O + H_2O = 2Fe(OH)_3 + 2CaCO_3$$

In the absence of ferric carbonate the carbon dioxide radicle combines with whatever element is available. This oxidation of ferrous iron also explains why air is required in so much greater quantity than is needed, theoretically, for the solution of gold and silver.

The ore in question is that from the Veta Colorada mine, near Parral, Mexico, where the Alvarado Mining Co. and the Veta Grande unit of the American Smelters Securities Co. are operating cyanide plants. The cause of this consumption was discovered while I was conducting cyanide tests at the Veta Grande plant, but the same condition exists at the Alvarado plant. The ores under investigation were all from above water-level, and were of the following approximate analysis:

	%		%
Insoluble	75.00	Pb	0 25
Ferric iron	3.00	Cu	Trace
Ferrous iron	2 00	Zn	1.25
Al_2O_3	4.00	Mo	Trace
CaO	4.80	Sb	Trace
Mn	0.60	S	0.08
Mg	0.20		

The ore varies from a slightly silicified andesite to nearly pure quartz or calcite, the more highly silicified ore being characterized by a higher iron content and a lighter color than the predominant surface ores, which are of a deep-red color (hence the name of the vein), in spite of their relatively low percentage of iron. The actual lime consumption in the plant varies with the length of treatment, but not in proportion; the consumption decreases as the amount of ferrous iron present becomes smaller. Sodium ferrocyanide is not formed in the treatment of these ores so long as lime is present in amount above 0.005%. The solutions at the Veta Grande plant showed no trace of ferrocyanide after being in continuous use for over a year.

Results from the ordinary tests for alkali loss include the lime consumed by ferrous carbonate, so that the only benefit resulting from a knowledge of the cause would lie in an appreciation of time as an influence on the amount of lime used. Shortening the time of treatment decreases the quantity of lime required, and this may be an important item, especially where low-grade lime must be used.

In discussing the de-aeration of solutions before the Chemical, Metallurgical and Mining Society of South Africa, Thomas B. Stevens drew attention to the work that has been done in Western Australia in connection with what is known as the Coolgardie water scheme. The water is pumped from Nundaring to Kalgoorlie, a distance of 350 miles, through a 30-in. diameter steel pipe; in traveling this distance it is pumped eight times. Early in the life of the main there was a rapid increase in friction, and the inside of the pipe became heavily coated with rust nodules. A committee of experts who investigated the trouble advised that lime be added to the water, and also that it be de-aerated. The addition of lime alone was first tried and was found to be inadequate. A de-aeration plant was then installed, and this has been so successful in stopping the corrosion that the use of lime has now been discontinued. The de-aerator is of the mechanical type, the water being sprayed into a tower and subjected to vacuum, 90% of the dissolved oxygen is extracted, and the remaining 10% is found to be absorbed in the first 30 miles of pipe. The water as delivered to the mines at Kalgoorlie shows no oxygen by the alkaline pyrogallate test. The amount of water delivered is 2,000,000 gal. per day.

Treating the Copper Impurity in Lead Ores

By D. C. McGruer

*The question of dealing with the small quantities of copper found in many purchased ores became a factor of importance when the Sulphide Corporation decided to refine its own lead bullion, as the presence of this impurity has a marked effect on the efficiency of the de-silverizing operations of the Parkes process.

The copper is removed from the base bullion by drossing, which collects the copper, and, in addition, some gold, silver, and lead. The drossing of the bullion is done in two stages, at the smelter and in the copper kettles at the refinery. In both cases a 'wet' dross is produced, which is subsequently 'sweated' in a suitable furnace. When 'dry', the dross is raked out and stored until enough accumulates to warrant a run in the small blast-furnace kept for that purpose.

A typical assay of the 'dry' dross is as follows: Gold, 0.3 oz. per ton; silver, 55 oz. per ton; lead, 60-70%; copper, 6.5%; iron, 2.2%; zinc, 1.5%; tin, 4.5%; arsenic, 1.6%; and sulphur, 4.5%. The accumulated dross is treated in a small blast-furnace with the necessary fluxes, producing a low-grade copper-lead matte and base lead bullion. The assay of the matte is approximately as follows: Gold, 0.05 oz. per ton; silver, 30 oz. per ton; lead, 32.2%; copper, 23-25%; iron, 25%; zinc, 3%; antimony, 5.6%; arsenic, 3.3%; and sulphur, 14.4%.

This matte was formerly crushed, roasted, then leached with sulphur, and copper precipitate produced; but, owing to the shortage of scrap-iron, another method of converting the copper into a marketable form was considered. The conversion to bluestone appeared to be practicable; the low-grade matte is crushed through a ¼-in. screen, given a quick roast in the rotary furnaces, then passed over a Dwight-Lloyd machine, and is finally worked up to high-grade matte in a reverberatory furnace. In working the low-grade to high-grade matte, the time of treatment is gauged by the iron content of the charge; when a dip sample shows the iron to be about 2%, the charge is tapped, irrespective of the amount of copper present. The lead loss in fume is high, but provision is being made to connect the reverberatory furnace to a bag-house.

An average assay of the high-grade matte produced is as follows: Gold, 1.125 oz. per ton; silver, 69 oz. per ton; lead, 24%; copper, 47%; iron, 2%; zinc, 2.4%; and sulphur, 17%.

The high-grade matte is crushed in a Krupp mill through a 40-mesh screen, roasted in a 4-hearth hand reverberatory furnace, and then passed to the leaching department for the production of bluestone. The temperature when roasting is between 600° and 625°C., the following temperatures being maintained under working conditions: No. 1 hearth, 460°C.; No. 2, 532°C.; No. 3, 582°C., and No. 4, 618°C. An average sulphur assay of the roasted product is as follows: Total sulphur, 7.7%; and sulphur as SO_3, 7.4%.

The copper in the matte is dissolved by leaching with dilute sulphuric acid in a circular agitation-vat provided with a wooden paddle, which is driven by a spur-and-pinion wheel fitted over the top of the vat. Two agitators are in use for leaching the roasted matte or for purifying the neutral leach liquors. Sometimes one is being used for treating the matte and the other for purifying the liquors, and at other times they are both used for purifying accumulated neutral liquors. The production of a neutral impure liquor takes from 1 to 5 hours, whereas 5 to 15 hours is necessary for purification, according to the quantity of iron present; therefore an accumulation of impure neutral liquor takes place.

In making up neutral liquors, the roasted high-grade matte is carefully weighed, then tipped into the agitator, which has been previously filled to the correct level with water (or acid wash liquors from a previous charge), and a calculated quantity of sulphuric acid. Sufficient acid is added to give a neutral liquor containing 70 to 80 gm. of copper per litre. The temperature of the liquor is kept at about 70°C. by means of live steam delivered to the bottom of the agitator. Samples are taken during the agitation, and a test is made for copper, iron, and sulphuric acid. When there is a sufficiency of copper and when the solution is neutral, agitation is stopped, the steam is turned off, and the pulp is allowed to settle, the clear liquor being decanted and sent to the storage-vat for impure neutral liquors. It has been found that at least three leaches can be made before it is necessary to discharge any residue. The amount of copper in the matte controls the size of the charge to the agitators, as well as the number of charges treated before discharging a residue.

After the third neutral liquor has been decanted, two successive acid washes are given to the residue. Each wash is given about two hours agitation with 5 to 10% sulphuric acid. Live steam is used to raise the temperature to about 60°C. Periodical tests of the wash-liquor for copper and acid are made; and, when no further increase of copper in the solution is shown, the agitation is stopped, the pulp is allowed to settle, and the clear acid-wash liquor is sent to the wash-water storage-vat. From there it is subsequently pumped back to the agitator for the next charge, to make up neutral leach liquors of the required strength. After the second acid wash has been decanted, sufficient water is added to flush the residue from the agitator, through a bottom discharge, into the first of three cone-shaped settling-vats, which are ter-

*Abstracted from a bulletin of the Aust. I. M. M.

raced to permit the solution to flow from the first to the second, and so on, finally reaching the storage-vat for acid-wash liquors. In these vats the pulp settles, and the clear wash-water, which contains a little copper, is either displaced by adding fresh water to No. 1 or by decanting to the acid-wash storage-vat. The thickened pulp is discharged through a bottom-discharge pipe into a large brick bin, where it is allowed to dry sufficiently to be sent to the roasting-department. All bluestone-plant residues, which represent about 40% by weight of the original high-grade matte leached, are incorporated in the H. & H. pot charge, which forms part of the ordinary daily charge to the blast-furnace. Of the metal in the high-grade matte, all the gold, silver, and lead are retained in the residue, together with 46% of the iron, 32% of the zinc, and 9.5% of the copper. The gold, silver, and lead are thus separated from 90.5% of the copper, and are subsequently recovered with the bullion produced in the blast-furnace, the copper that escaped solution being again removed by drossing.

Purification of the Liquors. Iron is the chief removable impurity; during its precipitation the whole of the arsenic and antimony are also precipitated. The Hofmann system of purification is employed. In the presence of air and copper oxide (in hot liquors) ferric sulphate is oxidized, then precipitated as ferric oxide, and a chemical equivalent of copper goes into solution as copper sulphate. A departure from the somewhat elaborate purifier, as described by Hofmann, has been made; all liquor purifications are carried out in an ordinary agitation-vat. Several methods of applying the air have been tried, but the best results have been obtained by delivering both air and steam at a point near the bottom of the agitator, either by two independent lead pipes of equal length strapped together—one for air and the other for steam—or by mixing the air and steam in one lead pipe, which is fixed securely to the inside of the agitator by means of wooden cleats.

The agitator is filled to the correct level with impure neutral leach-solution. A sample of the liquor is taken, and tested for iron in the ferrous state; the agitator is then started, and steam and air are turned on. For the necessary copper oxide either ordinary roasted high-grade matte or roasted copper precipitate is used; as the temperature rises in the agitator, about 300 lb. of roasted matte or precipitate is added. The progress of the purification is carefully controlled; a sample of the liquor is taken every hour, and a test is made for ferrous iron by acidifying the sample with sulphuric acid and titrating direct with standard potassium permanganate. In the presence of the added copper oxide (in the roasted matte or precipitate), no appreciable iron in the ferric state is found in the solution; therefore a titration for iron in the ferrous state gives a true working indication of the total iron in the solution at any stage of purification. The amount of iron in the impure neutral liquors varies considerably, according to the amount of the iron in the matte treated and the completeness of the roasting. The maximum iron found in the impure leach-liquors is about 10 grammes per litre, and the minimum about 2.0 to 2.5 grammes.

The degree of purification desired is from 0.15 to 0.2 gm. of iron per litre. From 5 to 15 hours of agitation and aeration is necessary; when the purification is finished, the agitator is stopped, steam and air are turned off, and the charge is allowed to settle. The clear solution is then decanted and sent to the storage-vat for purified liquors. The following tabulation shows the completeness of the removal of iron, arsenic, and antimony, the zinc being unaffected:

	Grammes per litre				
	Cu	Fe	As	Sb	Zn
Impure liquor	73	5.1	1.05	trace	3.0
Purified liquor	80	0.15	trace	nil	3.1

After decanting the purified liquor, the residue, which contains a considerable amount of precipitated ferric oxides, is given a weak acid wash to dissolve the unconverted copper oxide. About three hours agitation is given. The residue is allowed to settle, and the liquor is decanted to the acid-wash liquor-storage vat. If necessary two acid washes are given; then the residues are discharged, with water, in exactly the same manner as ordinary leach-residues when making up neutral impure liquors. All acid-wash water is used as subsequent leach-solutions for fresh charges of impure liquor.

Concentration of the Purified Liquor. The main evaporating pan is a rectangular lead-lined wooden vat of 750-gal. capacity. The first arrangement consisted of six 4-in. lead-covered boiler tubes, let into the vat longitudinally, with a fire-box, suitable for burning coke, at one end, and a chimney at the other. The rate of evaporation proved to be too slow, and the coke consumption was abnormal. Steam-coils were then used, the first being made of 1-in. soft-lead piping. The best results have, however, been obtained by using 1½-in. antimony-lead piping, containing 4% antimony. On account of the strength of the hard-lead piping, the scale can be removed periodically without injury to the coil. An analysis of the scale that forms is as follows: Lead, nil; copper, 28.8%; iron, 0.4%; zinc, 0.9%; antimony, trace; arsenic, 0.9%; sulphur, 14.5%; and sulphur as SO_3, 14.5%.

The evaporator will not hold enough concentrated liquor to fill a crystallizing-vat, therefore when the liquor in the evaporator has attained a specific gravity of 1.4 it is sent to a storage-vat provided with a lead coil, using the waste steam from the evaporator. This storage-vat acts as a concentrator, and also as a means for thoroughly clarifying the liquor before it gravitates to the crystallizers, where it is delivered at a specific gravity of from 1.42 to 1.43, and at a temperature of from 80° to 85°C.

Crystallizers. The crystallizing-vats are made of brick; they are lined on the sides with 8-lb. sheet-lead, and on the bottoms with 10-lb. sheet-lead. The vats are 8 ft. by 10 ft., by 2 ft. 9 in. high. To give the maximum surface on which the bluestone crystals can be built, each vat has 112 sheet-lead strips, 8 in. wide and 4 ft. 3 in. long, hung on 4 by 2-in. hardwood battens, and allowed to extend down to within about 7 in. of the bottom. When

it is desired to fill a crystallizer, all the strips are placed in position; the hot concentrated liquor is then gravitated from the storage vat: the surface is protected with a hessian cover, and it is allowed to cool slowly. From 2 to 2.5 tons of dried bluestone is made per charge.

When the crystallizer is to be emptied, the mother liquor is removed by means of a steam-ejector. The crystals are knocked off the strips and sides, then shoveled out and delivered to the washer.

Treatment of the Mother Liquor. An average analysis of the mother liquor in grammes per litre is as follows: Copper, 84; iron, 0.8 to 2; zinc, 11; and free sulphuric acid, 1.8. Its specific gravity is 1.26. The original procedure was to concentrate further the mother liquor, and to produce a second crop of bluestone, but it was found that the resulting crystals were of low grade, which necessitated re-dissolution and re-crystallization. The bluestone contains: copper, 24.95%; copper sulphate, 97.5%; iron, 0.065%; and zinc, 0.15%.

As only a first-class grade of bluestone is being boxed for sale, the necessity of re-dissolving the low-grade bluestone reduced the capacity of the plant to such an extent that some other means of dealing with this product had to be devised. The present practice, which overcomes the production of any low-grade bluestone, is to by-pass and run over scrap-iron a definite quantity of mother liquor each week, returning the remainder to the purified-liquor storage-vat. The result is that no accumulation of zinc (which is the chief impurity) takes place, and only high-grade bluestone is produced.

The copper precipitate from the mother liquor, which is by-passed, represents about 15% of the copper leached from the matte. It is roasted, and returned to the purifier as a source of copper oxide. The only bluestone now being re-dissolved is the undersize from the hutch of the washer. This is dissolved in mother liquor in an agitator provided with a paddle and steam-coil. The crystals are added to the liquor until a specific gravity of 1.435 is obtained. The liquor then goes to the crystallizer, together with ordinary concentrated purified liquors.

Treatment of the Bluestone. The bluestone, as it comes from the crystallizing-vats, has to be washed and freed from any fine crystals. This is done in a jig, with a fixed screen. Mother liquor is used as the wash-liquor. The screen has 3/32-in. holes, which allow the undersize crystals to pass through into the hutch; from there they are periodically shoveled and sent to the re-dissolver. The washed crystals are shoveled from the jig screen into a centrifugal drier, from which they are transferred, when properly dried, to a screen, giving two products, minus ¼ in. and plus ¼ in. The boxes used are made of pine, and have an inside dimension of 20 in. by 10 in. by 12 in. Each box is lined with brown paper before being filled, and holds 1 cwt. of bluestone, of either the coarse or fine grade of crystals, and is branded C or F, according to which grade of crystals it contains. An analysis of the finished article is as follows: Copper, 25.26%; copper sulphate, 99.23%; nickel, 0.002%: zinc, 0.09%; magnesia, trace; lime, trace; aluminum and iron oxide, 0.07%; arsenic, trace; antimony, trace; selenium and tellurium, trace; nitrates, nil; insoluble, 0.02%. It will be noticed that, although about 15% of the copper leached from the high-grade matte is by-passed and precipitated on scrap-iron, the precipitated copper is roasted and returned to the purifier; therefore, by the method above described, a metal, which is considered as an impurity in lead smelting, is separated from the gold, silver, and lead, and converted into a profitable by-product.

Oil-Shale Exploitation

In the summary of a report on the oil-shale industry, recently issued by the Bureau of Mines, it is pointed out that:

1. Many American shale deposits are richer in recoverable oil than Scotch shales now being worked, and probably nearly equal in nitrogen content, which is a measure of recoverable ammonia.

2. Market conditions for shale products are less favorable in this country than in Scotland.

3. Great quantities of American shales are of greater thickness, and are better suited for mining than Scotch shales.

4. As yet no process for obtaining oil from oil-shale has been used in actual commercial practice in this country.

5. Indications are that the United States cannot continue long to depend on domestic petroleum production to supply completely the demand for petroleum products; and that, sooner or later, oil-shales will have to be used to help supply the deficit.

6. The shale-oil industry cannot hope to supplant the petroleum industry in a large way for many years, but will probably grow up from local industries in favorable places.

7. Costs of oil-shale operations cannot be reliably estimated until commercial practice in this country furnishes the necessary basic data.

8. The quantiy, quality, and value of products and by-products to be obtained from oil-shale in this country are not known with any degree of certainty.

9. The oil-shale industry is a large-scale, low-grade, manufacturing enterprise, requiring large capital, high technical and business ability, and probably making slow return on the investment. Once economic conditions become favorable for the development of the industry and satisfactory mining, retorting, and refining processes are worked out and markets established, there should be only ordinary business risk connected with the industry.

Considerable railroad construction and development in the Belgian Congo is planned for the near future, states a consular report. The road from Matadi to Leopoldville is to be reconstructed at a cost of 10,000,000 francs. The Katanga railway is to be extended at a cost of 30,000,000 fr.; 20,000,000 fr. is to be expended on the construction of the first Belgian portion of the Benguella railway. About 25,000,000 fr. will be spent for railway material for the Great Lakes railway.

Ventilation in Metal Mines

By D. Harrington

*Those in control of metal mines have paid little attention to the question of air circulation until forced to do so, although the subject is as important as is the case with coal mines. The coal-mine engineer must remove a dangerous gas, methane, the fumes from explosives, and other gases such as carbon dioxide or nitrogen; in metal mines there is even greater necessity. In addition, air currents are needed to reduce humidity, and temperature, and to remove the fine particles of rock dust that float in the air and are largely responsible for miners' consumption. Coal miners live to a ripe old age; many metal miners contract disease and either die early in life or are incapacitated in middle age; this is due almost wholly to the superior working conditions in coal mines, chiefly because of efficient ventilation.

The worker in a metal mine frequently works under conditions analagous, as regards heat and humidity, to those found in some of our large cities. In addition, he frequently has to breathe air that is laden with fine dust and poisonous gas. He may have to pause several times daily to wring perspiration from the few pieces of clothing he wears, and even to pour perspiration from his shoes. The atmosphere near a working face is often similar to that which would be produced in a sleeping room in which all the windows were closed tightly, and where ventilation was only possible through an open door connecting with the hall-way. The sleepers would suffer from headache; the miner's discomfort is aggravated by the presence of dust, by gases from the explosives and from decaying timber, and possibly from the high temperature and the high humidity of the surrounding atmosphere. These conditions will be alleviated only to a slight extent by the release of compressed air.

Mine Investigations. The following data have been obtained during observation in over 50 mines in 10 States during the past five years, supplemented by observations during the past 20 years in over 150 coal mines in 15 States, and in over 100 metal mines in 14 States. In addition, I have had access to reports by other investigators. In one large metal mine the workings extended almost from the surface to below the 3000-ft. level. Data were obtained at 158 working places, of which 87½% were below the 2000-ft. level, and 35% were below the 2500-ft. level; about 75% of the observations were made at actual working places. It was found that the average wet-bulb temperature of 158 places was 76.8°F. and the average humidity was 91.3%. There was sufficient movement of air to be detected by ordinary observation in 42 out of 158 places; in an additional 29 places the movement could be detected only by a slight inclination of a candle flame; in 87 places (or in over 55%) there was no detectable movement of the air. Wet-bulb temperatures were as follows: 40 places, under 70°F.; 45 places, from 70° to 80°; in 61 places, from 80° to 85°; in 12 places, over 85°F. Humidities were as follows: in 22 places, under 85%; in 12 places, 85 to 90%; in 51 places, 90 to 95%; in 73 places, over 95%.

In the places with the high wet-bulb temperature and high humidity, where there was little or no movement of the air, men were doing the hardest and most important work, that is, at the working face—in drilling, mucking, shoveling, or timbering. A comfort rating was given to each place, the result being compiled as follows: 78 places, with an average wet-bulb temperature of 72.1°F. and humidity of 88.2%, were rated as 'comfortable'; 80 places, with average wet-bulb temperature of 81.4°F. and humidity of 94.2%, were said to be 'uncomfortable'. Out of 85 places with a wet-bulb temperature less than 80°F., 73 were rated as 'comfortable', irrespective of air movement or humidity; an 'uncomfortable' rating was given to those places with a wet-bulb temperature that was less than 75° F. only if excessive dust or gas were present, or if the dry-bulb temperature were high, say up to 100°F.; in the latter case and if the air were moving at the rate of 500 ft. per minute, or over, the place was rated as 'comfortable'. In this mine about 400 men were employed underground per shift; the total quantity of air supplied was about 60,000 cu. ft. per minute. Underground temperatures of rock and water varied from about 60°F. near the surface to 104°F. in the lowest levels.

The accompanying tabulation gives data as to ventilation in nine fairly large mines. It is noticeable that the average wet-bulb temperature of all the underground places visited lies between 70° and 80°F.; the humidity is 85%, or over. Mines 1 and 2, with an average wet-bulb temperature of 72.5°F. and 72.3°F., respectively, had but 14% and 25% of places that could be rated as 'uncomfortable', although 96% of the places in Mine No.1 and 100% of the places in Mine No. 2 had a humidity of over 85%. It is noticeable that in all mines with a wet-bulb temperature of 75°F., or over, half the places were rated as 'uncomfortable'. These two facts seem to indicate that 75°F. is the highest average wet-bulb temperature at which comfort can be expected, irrespective of humidity, movement, and, possibly, dry-bulb temperature. It is also noticeable that a humidity of 85% or over was found in more than 60% of the places visited and in 75% of the places of all mines but one. Air movement was almost or entirely lacking in over 60% of all places visited in four of the nine mines. The places with stagnant air were almost invariably the working places.

*Revised abstract of original paper, published with permission of the Director, U. S. Bureau of Mines.

CONDITIONS IN METAL MINES IN THE UNITED STATES

Mine	Number of places	Wet bulb, °F.	Humidity, %	Comfortable places, %	Uncomfortable places, %	Wet bulb over 75°F. % of places	Humidity 85% or over. % of places	Air movement Little or none. % of places	Climate: Season	Climate: Temperature	Climate: Humidity	Average mine depth
1	28	72.5	94.7	86	14	14	96	32	Summer	Hot	Dry	About 600 ft.
2	20	72.3	93.2	75	25	[illegible]	100	40	"	"	"	" " "
3	61	75.5	89.0	42	[illegible]8	54	[illegible]2	46	Fall	Medium	Medium	" 1800 "
4	28	78.3	90.0	25	75	82	75	25	Winter	Mild	Humid	" 1600 "
5	16	78.0	93.0	31	69	87	100	44	"	"	"	" 1200 "
6	11	75.1	94.0	37	63	64	91	91	"	"	"	" 1200 "
7	158	76.8	91.3	49	51	74	86	73	"	Cold	Dry	" 2500 "
8	87	77.8	85.2	32	68	76	[illegible]8	75	Summer	Medium	Medium	" 2200 "
9	77	74.5	87.7	*	*	60	75	64	"	"	"	" 2200 "

*Not rated as to comfort.

The nine mines in the tabulation employ a total of about 5000 men underground during three shifts; five have extensive workings, are large producers, and are known as being well ventilated.

Conditions Affecting Metal-Mine Ventilation. The temperature of the air underground is affected by the temperature of the outside air, dependent on the depth and the extent of the workings, the velocities of air, and other considerations. The temperature of the mine air is affected by the temperatures of rock and water, by the quantity of air flowing, by oxidation or decay of timbers and ores, and by mine fires. It is also affected by the friction due to the velocity of flow, by the moving of ground, the firing of shots, the heat from lights used, and from the breathing of animals. Heated air from electric motors and from other machinery may also affect the temperature. The humidity of the air underground is affected to some extent by the humidity of the air on the surface, but much more by the moisture of the walls underground and by dripping water. Quantity, temperature, and velocity of air also affects the humidity; fans may be utilized to reduce the humidity of the atmosphere. Gases found underground may come from surface air, from the breathing of men and animals, from the lights used, from the firing of explosives, and from the compressed air used with machines or from blowers, from the operation of various kinds of machinery, from strata encountered, and from mine fires that are inactive or incipient. Dust is derived from dry drilling, from blasting, from shoveling, from tramming or dumping ore, and from timbering. Probably over 50% of all metal mines have silicious material in the ore, or in the containing walls. Silicious dust is the most dangerous of all dust, especially when taken into the lungs in an extremely finely divided form. Certain silicious dusts seem to be less injurious than others of the same composition. Non-silicious dust may be harmful ultimately; for example, the dusts of certain soluble-lead ores, which affect workers by skin absorption as well as by breathing.

General Conclusions. Ventilation, fire protection and prevention, health, safety, and efficiency are closely interlocked. There is as much reason for providing adequate ventilation for metal mines as for coal mines. Metal mines rarely, if ever, make provision for ventilation until forced to do so by some untoward condition or occurrence; coal mines, on the other hand, universally provide for ventilation. Efficient ventilation of metal mines consists in supplying circulating air at places where men work, so that they may exert themselves at maximum physical capacity without endangering health. Many metal mine officials are ignorant of the principles of air circulation, this being true of those technically educated as well as those without technical training. Workers in metal mines, including shift- and other bosses, must be educated to respect ventilating devices (such as doors, regulators, over-casts, brattices, fans) and to become as familiar with these devices as are coal miners; many metal miners and bosses consider ventilation a useless fad, and obstruct rather than aid improvements. Ventilation should be under adequate supervision; the person in charge should report to a high official; many local officials in metal mines are not in sympathy with ventilation betterments. Each mine should be ventilated within itself; interventilation of mines is likely to be dangerous, inefficient, and unsatisfactory. Every mine (coal or metal) should have a mechanically-driven fan, on the surface, in a fireproof house, that is capable of reversing the air currents without delay. Metal mines should be ventilated by fans in order to avoid danger from explosive fumes, and to provide fresh air for the workers. When the temperature of the surface air and that of the underground rock and water are about equal, in mines relying on natural ventilation the circulation of air may become sluggish or may reverse in direction. In time of a fire, naturally-ventilated mines are at a disadvantage, because of inability to control the direction of the air currents. There are records of naturally and inadequately ventilated mines which have filled with carbon dioxide or other gas. Some of the workers have been overcome, and work has been suspended. With efficient mechanical ventilation this trouble was avoided.

Workers in metal mines are much less healthy than workers in coal mines, because of the superior ventilation of the collieries. Miners' consumption is caused primarily by breathing fine particles of certain mineral dusts, especially silicious dust. Over 50% of our metal-producing mines are working in silicious material. It has been proved that the fine dust in metal mines remains suspended in still air for several hours; it causes miners' consumption, poisoning, and bronchitis; it is the cause of more deaths among our 175,000 metal miners than coal dust is among our 700,000 coal miners. Miners' consumption is caused chiefly by silicious dust. Investigations in our metal mines indicate that the air of mines so far studied is from 7 to over 40 times as dusty as in South African gold mines.

Intake air in metal mines is frequently dusty. A crusher-house may be near the collar of the shaft or of the air-intake shaft. The dustiest and most dangerous occupation underground is dry drilling, and the average dust content of air in five large mines in various parts of the United States was 205 milligrammes per cubic metre. For similar work in South African mines, but using precautions against dust formation, the air contains less than 5 mg. of dust per cubic metre. Regulations in several States are provided to prevent dust in drilling, but they are not observed. Miners appreciate the dangers from dust, but they often prefer to take the risk rather than to endure slight discomfort or extra trouble. Mine and State officials feel that, unless the miner will willingly aid, they cannot force him to protect his health and, incidentally, that of his family. It is my opinion that dry drills be supplanted by those that are equipped to prevent dust, and that the use of such devices should be enforced both upon miners and operators in metal mines. There is no valid excuse for dry drilling except in a few instances; spraying may be effective if used intelligently; on the other hand, it may intensify the dustiness of the air if used without intelligence. Efficient water-drills are now available, including efficient wet stopers for upper holes; dry drilling should be prohibited. Some dusty metal mines have comparatively little dust in the air at certain times, and a low average dust content of all places, because of the efficiency of ventilating currents especially at the working places. These mines appear to be singularly free from miners' consumption or other diseases, yet the employees work efficiently, and the material handled is highly silicious. The use of compressed-air blowers at working-faces frequently intensifies the dustiness, by allowing high-velocity air to pass through dry, loose, finely-divided ore or other material. Dust is probably the chief cause of miners' consumption, but it is now recognized that there may be other factors of almost equal influence, such as high temperatures and humidities, harmful gases, and lack of air movement, all of which may be modified by ventilation. It appears that, with a dry-bulb temperature below 75°F., mine working places may be comparatively comfortable, irrespective of movement of air or humidity. However, the presence of impure air may produce uncomfortable or unsafe conditions; such places may be both uncomfortable and unhealthful if large quantities of finely-divided dust are present. With a dry-bulb air temperature of above 75°F., comfort and maximum working efficiency can be attained only when air is moving, this being especially true if the air has a high humidity. The exact velocity necessary is a variable, dependent upon the temperature and the humidity. Saturated atmospheres, up to nearly blood-temperature, may be made endurable, and even comfortable, by providing sufficient velocity. The still air in metal mines at about 65°F. and 90 to 100% humidity has little effect on persons at rest, but with those doing even moderate work the body temperature rose to over 100°F., the blood-pressure fell perceptibly, and the pulse-beat rose. In still air, with temperatures of 90° to 100°F. and about 90% humidity, even when almost at rest the body-temperature rose quickly, reaching over 102°F., the blood-pressure fell rapidly, the pulse-beat increased abnormally and was sensitive to even slight exercise; perspiration was profuse; dizziness, physical weakness, mental sluggishness, and headache were common; upon attempting even light work these symptoms were greatly augmented.

Humidity, even up to the saturation point, does not appear to be harmful to health, comfort, or efficiency until the temperature is above 75°F.; if sufficient movement be supplied a high humidity is not harmful until the temperature is over 90°F. Except in blind working places the air is not particularly deficient in quality. However, the air of drifts, cross-cuts, raises, winzes, and stopes is likely to be deficient in oxygen, or high in nitrogen or carbon dioxide, and, possibly, in carbon monoxide, oxide of nitrogen, or other impurities. There are many records of asphyxiation in metal mines.

Almost all explosives used in metal mines give off small percentages of poisonous fumes; when these fumes are not removed from working places by ventilation they cause headache, nausea, and, possibly, death. The gelatin dynamites give off less dangerous gases than do the ammonium dynamites; the latter give off less than the straight nitro-glycerin dynamites. Hence the straight nitro-glycerin dynamites should not be used underground; and all places using explosives should be thoroughly ventilated after blasting and before the workers again arrive. Good ventilating currents should also be provided while the ore is being shoveled. Compressed air is not effective in removing explosive fumes. Comparatively small quantities of impurities in stagnant air causes headache, and this is particularly true when the temperature is over 80°F. However, these are not noticeable when there is perceptible movement of the air.

Frequently in blind and working faces in metal mines the air is so low in oxygen that a candle will not burn, and carbide lamps must be used; the oxygen content is below 18%. Occasionally entire mines are found in this condition, and many metal-mine managers contend that it is satisfactory. There is no question that men working in an atmosphere that will not support the combustion of a candle cannot operate efficiently; their health must suffer ultimately. Mines with cool working places are likely to be extremely dangeorus unless provision be made to remove explosive fumes and fine dust by ventilating currents.

The efficiency of workers in mines in which the temperature is high (above 75°F.) are likely to decrease from 25% to 75%. Workers are likely to become sick unless moving currents of air are supplied. The outcome is hastened and intensified if fine dust be present, especially silicious dust, and if there be much blasting done, especially when men are in the mine. Many accidents in metal mines are due to deficient ventilation. The failure to remove smoke and fumes prevents the proper inspection of working places. Moreover, men are likely

to be affected by dizziness or by lack of ability to think clearly or quickly, or they may faint at an inopportune time and be killed. Men have been known to drop dead from heart failure in these hot places.

Variations in surface-air temperature and humidity change conditions little, if at all, at the faces in those mines with extensive workings, hence underground temperatures in large mines vary little, if at all. Air that flows in underground passages rapidly takes the temperature of the surrounding rocks; the rate of change is variable. The temperature of still air underground rarely varies more than a few degrees from the temperature of the surrounding rock or water. Rock-temperature generally increases with depth, the rate of increase varying from one degree or more per 100 ft. of depth in certain districts of the western part of the United States, to 0.5° F. in other regions, both of the United States and of foreign countries. In Montana, the rock-temperature in copper sulphide veins is about 108°F. at a point 3800 ft. below the surface, the rate of increase being about 1°F. per 100 ft. of depth. In a lead sulphide vein in the Coeur d'Alene, in Idaho, the rock-temperature 200 ft. below the surface was but 50°F. In a Michigan copper mine with native copper ore, the rock-temperature was about 82°F. at a point 5000 ft. below the surface. In a gold-bearing quartz vein in Arizona, the rock-temperature was 90°F. at a point 600 ft. below the surface; in a deposit in another Arizona district, the rock-temperature 600 ft. below the surface was but 70°F. The temperature of coal in place in coal mines in the United States is rarely above 70°F., and is generally much less. Recent magazine articles give the rock-temperature of the Kolar goldfield in India at 118°F. at a point 6100 ft. below the surface, and 98°F. at the 4000-ft. level of the St. John Del Rey mine, in Brazil; it is calculated that at the 800-ft. level of the City Deep mine in South Africa the rock-temperature will be about 97°F. Rock-temperatures may vary at the same depth in different kinds of material; a copper sulphide ore with quartz gangue may have a rock-temperature several degrees higher than a zinc-sulphide ore in a quartz gangue in a parallel vein about 200 ft. distant.

Water standing still or flowing in mines readily communicates its temperature to the surrounding air. Water dripping through the air quickly brings the air to the temperature of the water, which is generally the same as that of the surrounding rock. Mining engineers take advantage of the use of water-sprays to cool the air, but managers fear that water-sprays will cause excessive humidity, forgetting that mines generally have the humidity anyway, and that if the air can be cooled to 75°F. or below, and given a slight movement, the high humidity is not harmful. Recent experimental work in South Africa showed that men in stagnant air with a humidity of 95% and a temperature of 87°F. did more work after a fan was put in operation to move the air; high humidity is not particularly detrimental. Air passing through fans frequently has its dry-bulb temperature increased. In one instance, the air from an underground fan delivering over 20,000 cu. ft. per minute had 8°F. higher temperature at delivery than at intake, these points being less than 50 ft. apart. Similarly, small canvas-pipe units, used underground for local ventilation, frequently deliver air that is several degrees higher in temperature than that of the air at the intake. Small electrically-driven fans, with galvanized-iron or canvas tubing, are being introduced into metal mines to carry air to dead-ends. The galvanized iron has the advantage of permitting the reversal of air currents—to pull smoke out after blasting, then to force air to workers; moreover, it does not decay as fast as the canvas. The canvas tubing must be used only in forcing air to the face; its advantages lie in low first cost, readiness of installation and removal, flexibility in conforming to bends or turns, and ease of repairs. Moreover, because of readiness of installation and removal, the canvas tubing can be brought close to the working face at ordinary times, and easily removed prior to blasting. Either method readily permits of placing from 500 to 1000 cu. ft. of air per minute at the working face for a comparatively small cost. Compressed air from the end of a hose is used to a great extent to ventilate working faces in metal mines; its temperature rarely varies much over two or three degrees from the temperature of the rock and air of the working face. Such a method is useless for the removal of smoke or gas, it provides comparatively little pure air, and ensures little reduction of temperature. The use of electrical machinery underground causes a considerable increase of temperature.

In the event of a fire in a metal mine, the lack of an efficient ventilation system may be disastrous. There should be a definite system of air-splits, so that fire in one place may not necessarily fill the entire mine with poisonous gas. There should be a system of doors, so that the shaft or any part of the mine may be readily isolated in case of fire. The lining of shafts with concrete will reduce friction to such an extent that additional air can be handled by the same expenditure of power. It is also found that in the case of small fans with canvas tubing, the same amount of air will be delivered with a saving of one-quarter to one-third of the power by the use of fans with one-half to two-thirds the width of the standard fans. If the lining is done by the use of 'gunite' it also serves as fire-proofing. The expense of establishing a ventilating system for a large mine varies, but the cost of operation is not particularly burdensome; it will be met by savings in compressed air, in increased efficiency, and in the improved health of employees; the savings effected may return the investment within a few years. Miners' consumption costs the mining industry in South Africa about $6,000,000 annually; it probably costs the metal mines of the United States more than that, in addition to many lives and much misery. By systematic work in dust prevention and ventilation, the death-rate from such causes in South Africa has been reduced from 35 per 1000 in 1910, to 13 per 1000 in 1915, and to about 11 per 1000 in 1920, the last figure including the casualties from influenza.

Book Reviews

The Fruits of Victory. By Norman Angell. 338 pp. Published by the Century Co., New York. Price, $3.

This is a sequel to 'The Great Illusion', which appeared in 1911. Mr. Angell's earlier book was widely read and made men think; it reached the heads of governments, but they disregarded his argument and unwittingly proceeded three years later to prove his main thesis—that war is an economic futility, even to the victor. In 1914, on the eve of the Great War, a friend greeted me one morning with the question: "What do you think now about 'The Great Illusion'?" He was one of many who thought that Mr. Angell had expected to stop war; indeed, he thought, I believe, that the author considered the possibility of another war as the illusion. Mr. Angell is too much of a philosopher to expect that his warning would convert an obstinate world to an immediate acceptance of his conclusions. So he returns to the charge. He might say now, pardonably, "I told you so. You have had an Armageddon, a war on a tremendous scale, between the principal nations; each of you expected results beneficent to yourselves; you even introduced sundry fine sentiments to glorify the horror of carnage and destruction; but what have you gained? What are the fruits of victory? The fruit is a Dead Sea apple, fair outside but turning to ashes when plucked". So Mr. Angell ventures again to preach disillusionment to a world that, he is warranted in hoping, is sadder and wiser—perhaps also in a better mood to heed him.

An unsigned introduction to the American edition of the book sets out to emphasize the importance of the subject to the American public. This may seem supererogatory, but I think not, for our people have felt the argument of experience much less than the Europeans and are hardly aware yet how much their own welfare is bound up with that of their neighbors—for neighbors all we are. That is one of the author's main arguments: the economic interdependence of the peoples of the earth. The "splendid isolation" that was the keynote of Great Britain's policy toward the continent of Europe was defended by reasoning similar to that now put forth by American publicists. We ought to realize that the aeroplane, the submarine, wireless telegraphy, and the innumerable ties of international commerce have ended any attempt to live alone, in economic and political detachment. Great Britain failed to preserve her isolation. We shall fail likewise. "Indeed", says the writer of the introduction, "Great Britain found that at no period of her history were her domestic politics so much dominated by the foreign situation as when she was proclaiming to the world her splendid isolation from foreign entanglements. It is as certain, of course, that American 'isolation' would mean that the taxation of Gopher Prairie would be settled in Tokio; and that tens of thousands of American youth would be sentenced to death by unknown elderly gentlemen in a European cabinet meeting."

The author writes his book in the form of summaries and accretions, detrimental to its literary quality but helpful to his purpose of convincing the reader. First comes a 'Summary of the Argument'. "Underlying the disruptive process", he says, "is the deep-rooted instinct to the assertion of domination, preponderant power. This impulse, sanctioned and strengthened by prevailing traditions of mystic patriotism, has been unguided and unchecked by any adequate realization either of its anti-social quality, the destructiveness inseparable from its operation, or its ineffectiveness to ends indispensable to civilization." In short, war is the result of a tradition that ignores the structure of civilized society, and is destructive of it. Next comes a 'Synopsis' of the seven chapters. He argues that the interdependence of peoples is such that to fight is suicidal, that war is the supreme futility, that the victor suffers no less than the vanquished, and that the victor has to assist the vanquished for his own self-interest in order to prevent a break-down in the machinery of civilization and the disintegration of social life. "The victor on the Egyptian vase has his captured enemy on the end of a rope. We say that one is free; the other bond. But as Spencer has shown us, both are bond. The victor is tied to the vanquished; if he should let go the prisoner would escape. The victor spends his time seeing that the prisoner does not escape; the prisoner, his time and energy trying to escape. The combined efforts in consequence are not turned to the production of wealth; they are 'cancelled out' by being turned one against another. Both may come near to starvation in that condition if much labor is needed to produce food. Only if they strike a bargain and co-operate will they be in the position each to turn his energy to the best economic account." Consider the relations of France and Germany today; consider our effort to resume commerce with those whom we helped to defeat three years ago. War is incompatible with the interdependence that is essential to the welfare of civilized peoples. The pugnacity that develops from patriotism breaks the ties that render possible a highly organized system of life on the earth. What price then are we willing to pay for a law that will protect this interdependence? As citizens we subdue our self-assertiveness for the sake of community life; how much of our national assertiveness are we willing to forego for the sake of the larger world life? If we do not restrain the combative instinct by self-discipline, we, as nations, shall plunge into the hellish futility of war after war.

Let me quote a few of Mr. Angell's most incisive sayings: "As interdependence increases, the limits of coercion are narrowed. Enemies that are to pay large indemnities must be permitted activity to develop their economic life and power; they are then so potentially strong that enforcement of the demands becomes correspondingly expensive and uncertain". "If to nationalist hostilities as we have known them in the past is to be added the commercial rivalry of nations now converted into traders and capitalists [he has laid stress on the growth of State Socialism as introduced for the purpose of conducting warfare], we are likely to have not a less but a more quarrelsome world, unless the fact of interdependence is much more vividly realized than in the past." He asks if we have the right to deny to others the means of life. "This 'right' to starve foreigners can only be invoked by invoking the conception of nationalism—'our nation first'. But the policy of placing life itself upon a foundation of preponderant force, instead of mutually advantageous co-operation, compels statesmen perpetually to betray the principle of nationality; not only directly (as in the case of the annexation of territory, economically necessary, but containing people of alien nationality), but indirectly; for the resistance which our policy (of denying means of subsistence to others) provokes, makes preponderance of power the condition of survival." He speaks from the British standpoint; the United States was not in the War as soon or as deeply as the others and did not feel compelled to shut off food from the enemy; indeed we fed our enemies immediately warfare ceased; but if we were in a war to the death, to preserve our national life, we also would not scruple to starve the enemy. "The greatest and most obvious need of Europe, for the salvation of civilization, is unity and co-operation. Yet the predominant forces of its politics push to conflict and disunity. If it is the calculating selfishness of 'realist' statesmen that thus produces impoverishment and bankruptcy, the calculation would seem to be defective." "In war-time, pugnacity, partisanship, coerciveness can find full satisfaction in the fight against the enemy. But when the war is over, these instincts, which have become so highly developed, still seek satisfaction. They may find it in two ways: in conflict be-

tween Allies, or in strife between groups within the nation. We may here find an explanation of what seems otherwise a moral enigma: that just after a war, universally lauded as a means of national unity, 'bringing all classes together', the country is distraught by bitter social chaos, amounting to revolutionary menace; and that after the war which was to wipe out at last all the old differences which divided the Allies, their relations are worse than before the War (as in the case of Britain and France)." "Instinct, being co-terminous with all animal life, is a motive of conduct immeasurably older and more deeply rooted than reasoning based on experience. So long as the instinctive, 'natural' action succeeds, or appears to succeed in its object, we do not trouble to examine the results of instinct or to reason. Only failure causes us to do that." The failure of the combative instinct provokes the inquiry to which the book is an answer. We ought to profit from experience in our relations as individuals. "We try other methods when we really discover that force won't work. When we find we cannot coerce a man but still need his service, we offer him inducements, bargain with him, enter a contract. This is the result of realizing that we really need him, and cannot compel him." "Faith in the social method is the condition of its success. It is a choice of risks. We distrust and arm. Others, then, are entitled also to distrust; their arming is justification for distrusting them. The policy of suspicion justifies itself. To allay suspicion we must accept the risk of trust. That, too, will justify itself." "If our instinctive pugnacities and hates are uncontrollable, and they dictate conduct, no more is to be said. We are helpless victims of outside forces, and may as well surrender." We do not intend to surrender. Man is a thinking animal, and by reason of his power of thought he has curbed some of the bestial instincts that he inherited from his early days in the jungle; it remains for him to curb others that are inconsistent with civilization.

The argument of the book is so closely knit that it is difficult to summarize. It should be read by every thoughtful man, especially in view of the forthcoming conference at Washington. Mr. Angell is not a discredited prophet, as some would have us believe; on the contrary, he has 'made good'; he did not say war was impossible, he said it was futile; he insisted that war on a large scale would become civil war and that civil war would be suicidal to humanity. He is justified by the event.—T. A. R.

Induction Motor, and Other Alternating-Current Motors. By B. A. Behrend. Second edition. 272 pp., ill., 6 by 9. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

The author explains that this is not a work of an encyclopedic character. It is essentially the work of an engineer who has had the good fortune to have been actively associated with the art of electrical engineering through almost three decades, and who has had a part in the development of the machines about which he writes. He reveals the methods that he has followed in design and construction of alternating-current motors. The design of electrical machinery, as of all machinery, we read, is based upon intelligent comparison of empirical data; and the art of designing cannot be taught without such data. The methods and principles enunciated in this book aim solely at creating means of effecting such comparisons. To 'calculate' a machine, as the term is frequently employed, is not feasible, and only principles and fundamentals can be taught in school. The author makes no apology for the number of personal references that occur. He points out that the tendency to write books without references is due largely to the desire on the part of the author to avoid consulting the papers of other writers. The reader is not benefited by such treatment, as he may frequently prefer the original paper to the abstract quoted by the author of the book he is reading. Besides, states Dr. Behrend, a knowledge of the literature of the profession is essential to understanding the art and to an honest interpretation of the part played therein by our fellow-workers. The contents of the book are as follows: I. Introduction. II. Theory of fluxes and stray fields. III. Alternating-current transformers. IV. McAllister transformations. V. Rotating field and the induction motor. VI. Induction generator. VII. Short-circuit current and the leakage-factor. VIII. Double squirrel-cage induction motor. IX. Polyphase commutator motors. X. Series polyphase commutator motor. XI. Shunt polyphase A. C. commutator motor. XII and XIII. Methods of speed control. XIV. Types of variable-speed polyphase commutator motors. XV. Methods of raising the power-factors of induction motors. XVI. Magentic pull with displaced rotor. XVII and XVIII. Single-phase induction motor. XIX. Single-phase repulsion motor. XX. Single-phase commutator motors. Appendix.

Chemical and Metallographic Examination of Iron, Steel, and Brass. By W. T. Hall and R. S. Williams. 501 pp., 5½ by 8½, ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $5.

This book, written by the translators of Bauer and Deiss' 'Sampling and Analysis of Iron and Steel', covers not only the chemical analysis of alloys but the examination of polished specimens. It is shown that the necessity for the chemical analysis of alloys has long been recognized, but modern methods of manufacture and the use of metals under conditions of severe strain demand additional information which can best be obtained by the examination of polished specimens. Part I deals with the chemical analysis of alloys, and includes well-tested methods of analysis, selected mainly from reports of the U. S. Bureau of Standards, or from papers of the American Society of Testing Materials. Although most of the standard methods of steel analysis are included, special emphasis has been placed on those methods that are rapid and accurate. Part II considers the physical rather than the chemical inspection of metals, and describes the methods of preparation and examination of polished metal surfaces as an independent means of determining the quality of material, as well as an aid in getting representative samples for chemical analysis. A brief introduction to metallography, in so far as it applies to the inspection of alloys, is included. A portion of the translation of 'Sampling and Analysis of Iron and Steel' is included in the book, notably several tables and a number of photo-micrographs.

American Electricians Handbook. By T. Croft. 823 pp., pocket size, ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

This is the second edition of a useful little book that was first published in 1913. In compiling it, the aim was to collect such information as would enable practical electricians to select and install commercial electrical apparatus and material, and to qualify them to operate the equipment after it had been installed. Theoretical discussions have been included only where they may be of assistance to enable the reader to understand why he should do certain things in certain ways. Although prepared primarily for the use of men with little schooling, it is designed to give practical information on materials, and suggestions for the selection, installation, and operation of equipment, that will be of service to the technically trained engineer. The volume, as now revised, comprises six divisions: Fundamentals, Generators and Motors, Outside Distribution, Interior Wiring, Transformers, and Electric Lighting. It will be found useful to the mining engineer, as well as reliable.

DEVELOPMENT OF FLIN FLON MINE INDICATES 25 MILLION TONS OF COPPER ORE

On the Flin Flon copper property, east of The Pas, in Manitoba, controlled by the Mining Corporation of Canada, development shows that the orebody occurs in lenticular form being 300 ft. in width at its widest point and tapering at the ends. A total of 43 diamond-drill holes have been put in and the deposit has in that way been explored to a depth of 1000 ft. In addition two shafts have been put down, one to a depth of 200 and the other 300 ft., and crosscuts have been driven at the bottom of each shaft. The development proves that the ore is of higher grade than was indicated in the diamond-drill cores. The average content, valuing copper at 13c. per pound, is approximately $7 per ton. The total proved, probable, and possible ore now indicated is estimated at 25,000,000 tons. The property is now idle, but with conditions moving steadily toward normal, it is not likely that active development will be long delayed.

MINING IS ACTIVE IN BEAVER COUNTY, UTAH

J. C. Brumblay, ore-purchasing agent for the United States Smelting Co., has been making a tour of mining properties in Beaver county in Utah. Mr. Brumblay reports that twice as many men are employed in the mines at present as there were a year ago. At the Humboldt mine, silver-lead shipping ore was recently opened on the 100-ft. level. This ore will average from 20 to 25% lead and carries considerable silver. Three streaks of high-grade ore are being followed in the Red Warrior mine, while a face of high-grade shipping ore is being worked in the Moscow property. After being closed for six months, the Wild Bill mine is being worked by lessees. Two shoots of ore are being mined, averaging from 20 to 25% lead and 7 to 8 oz. silver. The most promising property is the Gold Crown. An orebody in this mine has been followed for a distance of 500 ft. The ore is richer in lead and silver than any found in other properties in the district; the vein is from 2 to 5 ft. thick.

CERRO DE PASCO COMPANY PRODUCED 4,594,000 LB. OF COPPER IN SEPTEMBER

The Cerro de Pasco Copper Co. is one of the few big producers that is 'breaking even' on operations. The company's copper ore has a high silver content; silver sold at 73¼c. per ounce recently and this helps the Cerro de Pasco company materially.

In the first months of this year output totaled 39,810,000 lb. If the company keeps on turning out 4,594,000 lb. per month as it did in September copper production this year will total more than 53,000,000 lb. Output in 1920 was 52,790,000 lb. The high record year was 1917 when 72,674,032 lb. was produced. The company does not publish its silver or gold output. The metal is refined and sold by the American Metal Co., hence the company did not supply any of the 400,000,000 lb. of copper which was set aside and held for re-sale abroad by the Copper Export Association. To carry its own metal, Cerro issued $8,000,000 ten-year 8% bonds, convertible into stock at the rate of 30 shares for each $1000 bond. This financing put the company in a position where it was fully able to carry its own metal. It is estimated that the company produced about 6,000,000 oz. silver last year, and ought to turn out an equal amount this year, if copper production keeps on at the present rate. Due to the high gold and silver content of the ore, coupled with cheap Peruvian labor, Cerro ordinarily is one of the lowest-cost copper producers in the world.

PLANS OF THE COPPER AND BRASS RESEARCH ASSOCIATION

According to William A. Willis, general manager for the Copper and Brass Research Association, who just concluded a visit through the Lake Superior copper region, the copper and brass industries are not looking to the Government to rehabilitate them. They are prepared, he stated, to "fight their own fight" and believe public education and research are the best weapons. "It has been made clear to the copper and brass interests that not enough people understand the exclusive advantages of these metals," he declared. "Therefore a campaign of education has been undertaken, which, with the necessary research work, is being directed by the association. Copper and brass represent a higher initial cost than many other metals and materials that are sometimes used in their places, but the life of copper and copper products is everlasting, their service is uniform, they involve no upkeep expense, and, because of these things, they represent a substantial saving to the user in the long run. This is the message that copper and brass has for the American public." Mr. Willis likened copper's experience to that of the veteran who went to war and when he returned found somebody else in his place. Every pound of copper that could be mined and refined in this country was needed for war purposes, and when the conflict was over copper and brass came back to find that their places in many uses were being filled by substitutes.

AMERICAN MINING CONGRESS CONCLUDES ITS SESSIONS

The annual convention of the American Mining Congress held at Chicago was concluded on October 22, after five days of sectional conferences and general sessions. Twenty resolutions were adopted dealing with sundry phases of the industry. W. J. Loring was re-elected president for the ensuing year.

EXPORT OF OIL FROM MEXICO DURING SEPTEMBER

Exports of oil from Mexico in September were 17,637,179 bbl., one of the biggest month's shipments thus far. They compared with 5,528,000 in August and 6,215,000 in July, these two months being, of course, during the shut-down period. The record month thus far was January of this year, when 18,480,000 bbl. was exported.

Standard Oil Co. of New Jersey leads with shipments of 3,254,005 bbl. under its own name. To this should be added 1,103,750 bbl. exported under the name of International Petroleum of Maine, which was oil bought by Standard under its contract with International. This made 4,357,755 bbl. for Standard Oil for the month, or more than 25% of

the total. Mexican Petroleum Co. stood second with exports of 3,179,163 bbl. for the month, consisting of 55 tanker loads, probably the largest number of tankers loaded by any company in Mexico in a month.

Much of the oil moved in September came from storage, as several companies show shipments for September which may be considered abnormal in view of the fact that much of their production has been destroyed by salt water in August and September. This, particularly, refers to those which had sizeable production in Amatlan and are not producers in Toteco and Cerro Azul. It is from these two districts that the biggest part of Mexican light oil must come in future. For this reason the normal export of oil from Mexico may be said not to be more than 12,000,000 bbl. per month, after stored oil has been shipped.

Other exporters in September were Mexican Gulf Oil, 1,183,294 bbl.; Freeport-Texas, 361,649; Island Oil, 1,263,885; Atlantic Gulf & West Indies, 1,196,907; United States Mexican, 148,557; Texas Co., 986,491; New England Fuel Oil, 159,439; Continental Mexico, 212,520; National, 138,018; Cortez (Atlantic Refining), 427,669; Corona, 984,234; Interocean, 51,412; National Oil, 51,640; East Coast, 365,644; and Mexican Eagle, 1,568,900.

MINING ACTIVITY AT TONOPAH GREATER THAN FOR FIVE YEARS

With the Belmont, Tonopah Extension, Tonopah Mining, and West End companies operating with full crews, and the North Star, Rescue-Eula, New California, Jim Butler, Montana, and other properties yielding substantial quantities of good ore, the output of Tonopah district is the heaviest in five years. The Belmont, Extension, West End, Tonopah Mining, and MacNamara mills are running at capacity, with the Belmont plant at Millers also treating a good tonnage. Conditions at Divide are slowly improving, the result of recent ore developments in the Tonopah Divide and Gold Zone mines. Tonopah Divide is centring work on sinking of the shaft to the permanent water-level, development of the new gold lode on the 800-ft. level, and mining of ore on the main levels for shipment to the Belmont mill.

ALASKA

Hyder.—The towers of the Premier tramway are completed, and the work of stringing the cables has been started. It is thought that the tramway will be in operation before the end of November. There is to be a sale of a large number of Crown-granted claims on November 8 for delinquent taxes; among these are 50 claims on Queen Charlotte Islands, belonging to the Ikeda Mines, Ltd.——The Portland Canal Mines, Ltd., has started exploration work at the Big Missouri; 20 men are employed under Pat Daly and will continue explorations during the winter.——Pat Daly has bonded the New Alaska group, on the Alaskan side of the international boundary.——John Hoar and associates are opening up a gold property at Kellum lake, near Terrace, and are erecting a Ross mill.

ARIZONA

Bisbee.—W. H. Webster, assistant manager for the Copper Queen branch of the Phelps Dodge Corporation, has announced that steam-shovel stripping on Sacramento hill will be suspended on October 30. This will affect 150 men, but further work cannot be done economically until shipment of ore is commenced. Steam-shovel work on Sacramento hill was started more than four years ago. Since then 6,500,000 cu. yd. of material has been removed. The continuing of this work during the last few months furnished employment for many, and aided greatly in tiding Bisbee over the period of curtailment of activity. During the last few months a stock-pile of over 175,000 tons of concentrating ore has accumulated and about 375,000 tons of lower-grade ore has been placed on the leaching-dump site south of the new mill.

Kingman.—A cross-cut has been started in the east drift on the 100-ft. level at a point 250 ft. from the shaft of the Gold Chain mine. The cross-cut at 125 ft. from the shaft revealed a vein 16 ft. wide, the ore assaying approximately $16 gold per ton, according to reports.——A 25-hp. hoist and a No. 5 Cameron sinking-pump are now operating on the 400-ft. level of the Katherine mine. The purpose is to expedite the sinking of the winze near the face of the east drift on the 400-ft. level. According to reports, grab-samples from the winze at a point 22 ft. deep returned as much as $32 per ton.——Shaft-sinking has been resumed at the Revenue property. It is expected to sink to the 400-ft. level before cross-cutting is undertaken. New buildings, a hoist, and a compressor have lately been added to the plant.

CALIFORNIA

Bridgeport.—The Success Mining Co. has exposed a 3½-ft. vein of high-grade ore in its property in the Masonic district. The find was made in a drift north from the 50-ft. level. The Success mine was purchased by Elmer S. Green and associates from John H. and C. C. Hayes, of Bridgeport, in July.

French Gulch.—The deed transferring the Great American Copper mine from D. J. Williamson to Albert Hanford has just been recorded. The consideration is $10,000. The property adjoins the Greenhorn group, which was purchased by Hanford a few months ago.

Grass Valley.—The North Star company has increased its force by 100 miners during the last three months; there are now 460 men on the payroll.

Jackson.—The new compressor and motor for the Moore mine have been delivered. This equipment has considerably larger capacity than that in the present plant. Unwatering will commence as soon as the machinery is installed.

Oroville.—At the Gold Mary mine, near Gravel Range, 400 tons of rich quartz ore has been blocked-out. Work will be suspended during the winter, but a 3-stamp mill will be operated next spring.

Spanish Dry Diggings.—The clean-up at the Grit mine for September is reported as being $9000. A payment of $7500, due W. A. Buckman on the purchase price of the property, was made on October 18. The final payment of $20,000 is due on November 1, 1922.

Weaverville.—Preparations are being made by Grover and William Lorenz for operation during the winter. The Lorenz mine is the most important hydraulic mine in Trinity county.——W. R. Bigelow is building a new flume to the Enterprise mine near Helena. Mining will be resumed as soon as the rains commence.

COLORADO

Creede.—A new producer for the Sunnyside section is the Corsair, where lessees have opened up a strong body of silicious ore with good silver content. Shipments will commence soon.——A cyanide plant for the treatment of low-grade ores of the Monte Carlo group, will be erected if sampling now in progress is satisfactory.——The First National Mining Co., owning the Mollie S. group, has been re-organized as the Mid-West Mining Company.

Cripple Creek.—Connection through to the 20th level station has been made at the Vindicator No. 2, or main shaft, and timbering is in progress. Increased production from the rich Lillie ore-shoot, opened up while cross-cutting under the Vindicator shaft from the 1800-ft. level of the Golden

Cycle, will follow.——Diamond-drill prospecting has commenced at the Mary Ann, adjoining the Cresson, on Raven hill. The property is under lease to the Bull Raven Mining & Development Co., recently incorporated, also operating the Maude Helenas on Bull hill. A third shift has been put to work at the Independence mill of the Portland Gold Mining Co., and the plant is now operating at capacity on low-grade ores; company and custom ores are treated.

Lessees on the Gold King in Poverty gulch are maintaining steady production.——A rich pocket recently was opened by lessees at the 11th level of the Mary McKinney mine; a recent shipment settled for $5 per pound.

Florence.—The smelter of the River Smelting & Refining Co. is scheduled to resume treatment with a full operating force by the middle of November, according to H. H. Utler, general manager. The River smelter closed down last spring when about 200 men were laid off. The resumption of treatment will be of benefit to the Leadville district.

Hot Sulphur Springs.—The Electro Copper Co., whose property lies on the boundary between Eagle and Routt counties, has developed a large deposit of copper ore that is estimated to average 4%; 1850 ft. of drilling and crosscutting has been done from the main adit. The property is well equipped. William R. Rathbun is general manager.

Ouray.—Operations have been resumed by the Lucky Twenty Mining Co. on the Guadaloupe. A tunnel is projected to exploit the ground 500 ft. below the present deepest workings. The property is under lease to the operating company.

Silverton.—Capitalists from Pittsburgh, Pa., have become interested in the Kittimac gold mines, Minnie gulch; development work on both north and south veins is in progress.——An orebody has been opened in the Gladstone tunnel, south of Silverton, 4 ft. wide, with ore shipping 20% lead and 38 oz. silver per ton. A mill-run on 800 tons resulted in 100 tons of concentrate assaying 30 oz. silver, 24% lead, and 0.50 oz. gold per ton.

IDAHO

Coeur d'Alene.—A carload of ore is ready to ship from the Western Union mine. This is the first carload loaded by Kroan and Johnson since they secured a new lease. They have opened the orebody at a point 100 ft. east of where they were working, and the new opening is said to show ore carrying 80% lead and 40 oz. silver. The last carload shipped by these men under the old lease netted $2511.——Almost nine feet of clean lead-silver ore has been cross-cut on the Puritan level and on the level 200 ft. deeper in the Tamarack & Custer mines.——Work has been commenced on a one-mile tunnel to be run into the Ajax Mining Co.'s property at Burke, to secure additional depth of 550 ft. below the bottom of the present workings. Ajax ground has been worked through the Moonlight tunnel, for which the Ajax had a 10-year lease.

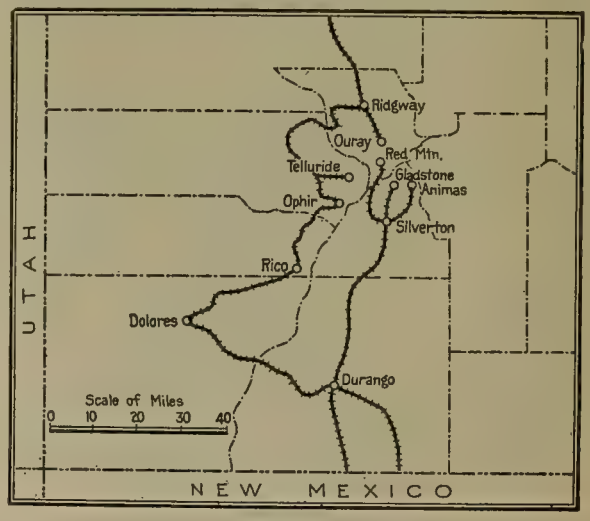
Three mining companies are concerned in the new development program of the Silver Reef Mining Co. In order to reach lower levels in its own property the Silver Reef has entered into a contract with the National Copper Mining Co. to use the lower tunnel of the Homestake Mining Co. The National controls the Homestake. By this arrangement the Silver Reef will develop its own ground and that of the Homestake and the National will be benefited by explorations in Homestake ground. The properties are near Mullan. The Homestake and Silver Reef have the same vein. The Homestake tunnel is in 400 ft. following the vein and must be extended 800 ft. to reach Silver Reef ground. Work under the new contract will be started at once by the Silver Reef company.

Talache.—The Armstead Mines will place its mill in operation on January 1 next, according to present plans. The building is almost completed and machinery for its equipment is arriving daily. Work in the mine is being pushed. The three-compartment raise has reached the 400-ft. level, giving it a height of 800 ft. or more above the main-tunnel level. The mine will be in a condition to deliver 150 tons of ore daily by the time the mill is ready to receive it. The average grade of this ore is 22 oz. silver per ton.

MICHIGAN

Houghton.—The Mohawk Mining Co. has brought suit for $125,000 for the use of the 14 miles of railroad between its mine and mill during the period of Federal railroad control and operation of the Copper Range railroad from June 25, 1918, to March 1, 1920. It holds this to be a fair and reasonable rental of its railroad facilities, having paid for hauling ore during that period upward of $350,000.

In connection with the discussion of the wearing qualities of copper for roofing, it is of interest to note that the Houghton county court-house, built in 1886, has a copper roof which has required no repairs and is as good as the



South-Western Part of Colorado

day it was put on; the tower of the town- and fire-hall of Houghton was covered with copper in 1883 and no repairs have been necessary to date, a period of 38 years.

The Michigan smelter, which treats Copper Range, Mohawk, and Wolverine mineral, has effected a notable economy by means of its coal-pulverizing plant. It has been in operation now for several months and is working smoothly and efficiently, the results being most gratifying. It has cut coal consumption down almost two-thirds in the furnaces. The coal is pulverized and is then automatically fed into the furnaces by means of compressed air. Whereas it formerly took 1500 lb. of coal to treat a ton of mineral it now requires only 525 lb. The plant was built at a cost of $150,000, but will pay for itself in three years' time. A possibility exists that some day powdered peat will be used as fuel in furnaces in place of coal. There are immense peat beds only a few miles from Houghton and these are now about to be developed, and one of the first experiments will be with powdered peat as fuel.

MONTANA

Butte.—Further experiments by the Anaconda Copper Co. in the manufacture of metallic shingles, made of an alloy of copper and zinc, have resulted in increasing the size of the product to a length of six feet, it being believed that this enlarged size will appeal to constructors as a time-saver on

roofing work. The company has tried out the life of zinc sheets for roofing and while these have stood remarkably well, they are not to be compared with those made of copper, tried upon one of the converter buildings at the Washoe reduction works. By making a shingle of an alloy of the two metals it is thought the ideal material has been developed. By the addition of copper to the shingle a thinner plate is possible.

The Anaconda has in mind certain improvements to be made at its electrolytic zinc plant at Great Falls, according to Frederick W. Laist, metallurgical manager, in which he said that the plans would result in better recovery, better current-efficiency, and lower operating and plant costs.——Butte & Superior recently won its appeal to the Montana State Board of Equalization in the matter of avoiding the payment of about $45,000 taxes on ore which had figured in the compromise settlement with the W. A. Clark interests in the recent Elm Orlu-Butte & Superior litigation. The State Board permitted a deduction of the amount which Butte & Superior had paid to the Clark interests in settlement of the suit and which had been included in the Butte & Superior valuation, in the making of the Silver Bow county tax-rolls.

Troy.—The milling operations of the Snowstorm Mines Consolidated have been proceeding steadily for two weeks. Two carloads of lead-silver concentrate has been shipped to the smelter. Development, during the period of milling inactivity, on the No. 7 level, exposed ore for 1000 ft. Besides opening a long shoot of ore available, the No. 7 level effects economy in transportation. Trains of 4-yd. steel cars are backed to points under the chutes for loading and are dumped automatically in the mill with no further handling. The upper levels are connected with the No. 7, thus providing the same economical conditions for the movement of ore. The distance between the mine and mill is 5½ miles. It is covered by a steam-railroad owned and operated by the company.——The Montana Morning Syndicate has opened a vein 15 ft. wide at the surface. The discovery was accidental and occurred when a pile of brush was removed. The new vein is 100 ft. east of the No. 2 shaft and contains lead-silver ore of high grade, according to reports.

NEVADA

Goodsprings.—Cobalt ore has been found here. The cobalt is present in the copper ores in this region, and in them only. Cobalt is not found in any of the ores of lead or zinc. The first cobalt was identified in a piece of ore from the Red Streak Mining Co., which resulted in the sampling of its dump, as well as in the prospecting for and sampling of other dumps. A number of chemists have identified the ore and a shipment of 1½ tons was made. One carload of 40 tons is now being prepared for shipment by the Red Streak Mining Co. The cobalt is in the form of both sulphide and oxide. A number of independent operators are working the dumps of various mines.

Pioche.—According to James Quirk, superintendent of the Black Metals mine, high-grade silver ore has recently been opened in the northerly inclined stope starting on the 325-ft. level. Specimen pieces assay as high as 1000 oz. silver per ton. Average sampling of the face of the incline gave the following results: 8 ft. at top of stope-face, silver, 27.6 oz.; 8 ft. across bottom, silver, 35.2 oz. per ton.

NEW MEXICO

Las Cruces.—Seventy-five miners are now employed in the Chloride Flat district in Grant county. Wright, Stauha, Armstrong & Bell, and others are shipping ore. The first named are sending out seven cars per week. The entire mineralized area was worked over at a depth of approximately 80 ft. in early days, but with silver at a dollar per ounce it is profitable to ship lower-grade material.——Development work on the Volcan property continues. On the 300-ft. level, where a cross-cut is being driven, ore assaying 100 oz. silver has been found. The cross-cut on the 200-ft. level is showing 9 ft. of good ore and the other wall has not been reached. Work on the north face at the 200-ft. level exposed ore running from 40 oz. upward.

OKLAHOMA

Douthat.—In spite of the poor prices for ore, the Skelton Lead & Zinc Co. is now operating four of its eight propertis at this place. The mines operating are No. 1, 4, 5, and 7.——The Admiralty Zinc Co. is operating two out of four properties here. It employs about 140 miners at the No. 2 and No. 3 mines, which have been operated throughout the low-price period. The zinc-blende is almost all of premium grade, reaching as high as 62.50% zinc content. The same interest owns the Sinden Zinc Co. mine at Cardin, which has been closed since March 1920, and the Queen Esther in the vicinity of Baxter Springs. The Admiralty properties are now under the management of M. B. Lawrence.——The Ramage Mining Co.'s mill here has been idle since September 1918. The Montreal, Quebec, and McClelland tailing-mill has been closed for several months. The Federal mill has been idle for over a year. Some parties took an option on the property recently, but did not make a trial-run.——The Fort Worth mine, owned by J. C. Squires & Co., situated in North Century, resumed about a month ago and is using about 40 miners. They are working at a depth of 210 ft. Glenn R. Squires is superintendent.——The New Chicago mine, situated east of Douthat, has been working since July 18 and is employing 80 miners. Its ore is at 140 ft.; this is shallow compared to other mines in this vicinity.

OREGON

Baker City.—Several shoots of silver-gold ore, ranging in value from $5 to $50 per ton, have been opened on the Black Bear group of claims, situated on Elkhorn mountain, by W. S. McQuain. The vein that he has been developing is from 5 to 12 ft. wide, and the outcrop can be traced for 2000 ft. The property is nine miles from Haines, the nearest railroad point, and is at an elevation of 5950 ft. The building of a road one-half mile long will connect the property to an excellent highway. Water for milling and timber for mining are available on the property.

UTAH

Alta.—One of the largest consolidations of mining companies made in Utah during recent years was completed on October 19, when articles of incorporation were filed by the South Hecla Mines Co. This company will take over the South Hecla, Albion, Alta-Utah, and South Hecla Extension properties. The South Hecla stockholders will receive four shares in the new company for each share now held; the Albion stockholders will receive share for share; Alta-Utah stockholders, one share of new stock for two and one-half shares now held; South Hecla Extension stockholders, one share of new stock for each eight shares now held. The capitalization of the new company is 5,000,000 shares, 2,000,000 of which will be used in taking up stock in the four companies involved in the consolidation. The remaining 3,000,000 shares will be held in the treasury. The par value of the shares is 10c. The acreage of the new company is about 1300 and includes practically all of the mining ground in the south half of this district. There has been driven in the four properties between 10 and 12 miles of tunnels, shafts, winzes, raises, etc., and the gross value of the ore produced to date is about $4,000,000. George H. Watson, president of the new company, states that the consolidation is for the purpose of securing more efficiency and economy in operation. George F. Wasson is vice-president;

Robert F. Marvin, secretary-treasurer; A. B. Watson and J. Will Knight, additional directors.

The Alta Transportation & Tunnel Co. has contracted for the hauling of a minimum of 10 tons of ore per day during the remainder of the shipping season, which usually lasts until Christmas. Shipments at present to the Murray smelter give net returns of about $40 per ton.

American Fork.—The Silver Contact Mining Co. owns three claims on the south side of American Fork canyon, on one of which an inclined shaft was sunk about two years ago. Ore said to average $65 per ton in silver and lead was uncovered, but a cave-in caused operations to be suspended. A tunnel has been started about 150 ft. below the shaft, and is now in a distance of 100 ft. Officials believe an orebody will be reached within the next hundred feet. C. G. Ballantyne is president.

Eureka.—Hugh Trenholm, manager for the various Knight interests, reports that the Iron Blossom and Colorado mines are attracting a large number of lessees; at present the working forces are much larger than they have been at any time during the past year. A contract has been let for a drift through a portion of the Dragon property, where a cave-in stopped production of ore. When this drift is finished, ore shipments to the Tintic Milling Co. will be resumed.

Ore shipments for the week ending October 15 totaled 142 cars, as against 178 cars for the preceding week. The Tintic Standard shipped 61 cars; Chief Consolidated, 33; Iron King, 10; Eagle & Blue Bell, 8; Iron Blossom, 7; Victoria, 7; Swansea, 4; Centennial-Eureka, 4; Colorado, 3; Bullion-Beck, 2; Eureka Mines, 1; Alaska, 1; and Sunbeam, 1.

Park City.—Seventy-five men are now employed at the Park-Utah mine, and this number will be increased, according to Paul Hunt, superintendent. A bunk-house, 28 by 58 ft., sufficient to accommodate 40 men, is being constructed and will be ready for occupancy early in November. Conditions in the mine are satisfactory.

During the week ending October 15, the Judge allied companies made the heaviest shipments of ore in many months, a total of 1051 tons being sent to the valley smelters. The Silver King Coalition shipped 829 tons and the Ontario 310 tons, making the total output 2190 tons, as against 1923 tons for the preceding week.

Good progress is being made in the construction of the milling plant at the Silver King Coalition property, according to M. J. Dailey, mine-manager. The structural-steel work is completed, and about 60% of the galvanized-iron sheeting has been placed. The crushers and rolls have been installed. It is expected the plant will be ready for operation about January 1. Exploratory work on the 1450-ft. level of the mine, in the M. L. M. fissure zone, is gratifying. High-grade silver-lead sulphide in a vein averaging 3 ft. thick has been opened.

Wendover.—Mining activity is being resumed in the Silver Island district, a short distance north of this station. W. W. Fowler has just completed a contract for tunnel work in the 'Hole in the Wall' claim. Samples taken from the face of the tunnel assayed 128 oz. silver and 18.3% lead. In the Salisbury mine, in the same district, Mr. Fowler reports that an 8-in. streak of ore has been opened, assaying 153 oz. silver and 17% lead. Development work will be continued in both mines.

WASHINGTON

Chewelah.—The United Silver-Copper Co. has followed high-grade silver-copper ore for 65 ft. on the 1400-ft. level, according to E. A. Wolfle, manager. Also it has followed ore of the same grade in a winze sunk 25 ft. below this level. The high-grade streak is 18 in. wide and contains an average of 70 oz. silver per ton and 11% copper. The winze will be continued to the 1500-ft. level, but the progress will be slow, as but one shift of two men is employed.

Oroville.—More activity is being shown in mining in this district than for 10 years, according to Horace B. Smalley, who is interested in the Rainbow group. He estimates that about 150 miners are now employed in the mines around Oroville. The ore is silver-lead, rich in silver. Most of the mines are shipping to the Tacoma smelter. There is some talk of trying to interest British Columbian mines now idle in forming a smelter company to take over the Northport smelter if a lease can be secured. By shipping to Northport the freight-charges would be cut in half. Resumption of operations at Northport would also encourage other mine-owners in the northern part of the State to resume operations.

ALBERTA

Pouce Coupe.—Later details of the find of natural gas in the well that the Imperial Oil Co. is drilling at Pouce Coupé, in the Peace River region, near the boundary-line between Alberta and British Columbia, indicate that the discovery is likely to prove important. After the initial flow, which was estimated at two million cubic feet per day, the boiler was moved back from the well, as ignition of the gas was feared. About 15 minutes after re-starting the drill another heavy flow of gas developed, estimated at 8,000,000 cu. ft. daily, which sent particles of tar-sand high into the air. After this second strike work was suspended, pending instructions from headquarters. It is thought likely that a 'commercial' flow of oil may be 'brought in'.

BRITISH COLUMBIA

Prince Rupert.—Heavy rains followed by swollen rivers have done some damage in the northern part of the Province. The cable-ferry across the Skena river at Terrace was carried away and smashed to pieces on the rocks. Bridges over the Bear and Salmon rivers are reported to have been carried away, and several of the bridges on the Alice Arm-Dolly Varden railway are reported to have been undermined, though the extent of the damage has not yet been ascertained.

Rossland.—Several hundred pounds of ore that carried 183 oz. gold was shipped from the I. X. L. mine recently. Eight men connected with the Consolidated Mining & Smelting Co. took a three-year lease on this mine. In cross-cutting they found stringers of rich ore.

Trail.—In the first nine months of 1921 the smelter of the Consolidated Mining & Smelting Co. of Canada received 307,493 tons of ore, compared with 251,735 tons in the same months of 1920 and 258,323 tons in the first nine months of 1919. Most of the ore is coming from mines owned by the company; 7629 tons came from other mines.

MEXICO

Chihuahua.—R. E. White, president of the R. E. White Mining Co., has called for a general meeting of stockholders to be held in the offices of the company in this city on November 3. A report of the past year's operations is to be rendered and a new board of directors will be elected.

Eduardo W. Enriquez has recorded application for the Hidalgo group of mines in the Urique district. The survey is to include the old La Chicharra and El Salto mines, which have been abandoned by the former owners.

General Ignacio Enriquez, governor of the State of Chihuahua, proposes to construct a telephone line to connect the principal mining camps in the remote western part of the State. The line will be about 475 km. long and will extend from Batopilas to Urique, Guazapares, Palmarejo, Rio de Plata, and thence to the station of Creel on the

Kansas City, Mexico & Orient railroad, where it will connect with the Federal telephone lines. The State government has also taken over the telephone line between the City of Chihuahua and the mining town of Santa Eulalia and is repairing it for constant and efficient service.

Durango.—Due to the probability of the Torreon smelter, owned by the Cia. Minera de Peñoles, and the Velardeña plant, of the American Smelting & Refining Co., resuming operations soon, and the continued advance in the price of silver, mining throughout the State is becoming more active.

A number of new filings have been made during the past week in the various districts. M. J. Bernard has located six new claims to be titled under the name of Tecolotes, which embraces the old abandoned Murecilagos properties in the San Bernardino district.——Gerald E. Norton, of Durango City, has denounced El Salvador group of gold and silver mines in the vicinity of Pueblo Nuevo.——Juan F. Martinez and associates have taken up three claims in the Todos Santos mountains in the Guanacevi district, which are to be patented under the name of Verdadero Faro.——Jose Calderon has discovered and located some tin mines in Los Remedios mountains a short distance west of the City of Durango, which he is developing.

NIGERIA

Jos.—The output of tin for Nigeria will be under normal for 1921, on account of low prices and high costs of material. Some mines have stopped producing, others have greatly reduced output. Ropp Tin, Ltd., is possibly the only company that will show an increased output. Almost every company producing will show a decrease in costs.

Some excitement has been caused by reported gold discoveries; no finds of high-grade ore have been confirmed. Gold has been found over a great part of Northern Nigeria, and possible payable lodes may be found.

ONTARIO

Cobalt.—The Nipissing during the first nine months of 1921 produced approximately 2,022,000 oz. of silver, or about 15% below the output of 1920. In money value the production is about one million dollars behind. Since May, however, there has been a steady improvement in the output, and the prospects for the remainder of the year are good. During September the company mined ore of an estimated net value of $197,536, of which $25,050 was cobalt, and shipped bullion from Nipissing and customs ore of an estimated net value of $164,405.

At the Victory preparations are being made to deepen the shaft from 200 ft. to the 500-ft. level. A cobalt vein carrying some silver was cut at 185 ft., and will be picked up at depth.

The new shaft of the Oxford-Cobalt on the Waldman is down 50 ft. Three small veins paralleling on the surface have joined and at the bottom of the shaft the vein is 2½ in. wide, but the silver content is lower.

Porcupine.—It is stated that the Ontario government has given the Temiskaming & Northern Ontario Railway Commission the right to develop power in the neighborhood of the Big Bend on the Abitibi river. It is proposed to utilize the power for the electrification of the road and offer the surplus for sale to the mining companies or other consumers. The capacity of the falls is estimated variously at from 15,000 to 30,000 horse-power.

The Porcupine-Davidson has appointed George E. Bent manager, and before sinking the main shaft is endeavoring to determine the position of the main orebody below the 1200-ft. level by diamond-drilling. Drifting is also being undertaken on the 600-ft. level. The working force is being largely increased; plans for a 500-ton mill are nearly completed.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Norman Stines is at Seattle.

J. B. Tyrrell was at Kirkland Lake recently.

W. E. Thorne has returned to London from Jos, Northern Nigeria.

W. H. Wellman has returned from Parral, Mexico, to Los Angeles.

C. V. Corless has returned from England to Coniston, Ontario.

Walter Fitch, president of the Chief Con. Mining Co., is in New York.

S. Ricker has moved from Sheep Ranch to Berkeley, California.

F. L. Sizer has returned to San Francisco from the Grass Valley district.

Ben. H. Cody has moved from Ajo, Arizona, to Excelsior Springs, Missouri.

Howard D. Smith was at Ruth, Nevada, last week, and is now in New York.

E. R. Hadie, Jr., of San Francisco, is at Katherine, near Kingman, Arizona.

C. W. Purington expects to sail from Vancouver for Siberia on November 18.

Arthur R. Weigall is expected in San Francisco at the end of this month, from Korea.

M. E. Cooley has been elected president of the Federated American Engineering Societies.

Frank G. Stevens is now engineer for the Makeever Brothers, with headquarters at Boston.

C. W. Adams, manager of the A. S. & R. smelter at East Helena, Montana, was at Salt Lake City last week.

Warren R. Sholes, of Murray, Utah, has been appointed Mineral Examiner of Utah for the U. S. Land Office.

Charles R. Davies is with the Mexican Corporation, at Fresnillo, Zacatecas, having left Salt Lake City, Utah.

Samuel W. Cohen was the official representative of the University of Minnesota at the McGill University centenary.

A. E. Perkins, Western manager for the Colonial Steel Co., has recently returned from an extended trip through Alaska.

J. E. Rypinski, recently at the Vipont mine, at Oakley, Idaho, is now with the Silver King Coalition Mines Co., at Park City, Utah.

Ross Taylor, assistant mill-superintendent for the Nevada Consolidated Copper Co. at McGill, was at Salt Lake City recently.

Henry Newell, of Ocean Park, California, a director of the Silver King Coalition Mines Co., has been spending some time in Utah.

R. C. Gemmell and **D. D. Moffat** are making a tour of inspection of the Ray Consolidated and Chino Copper companies' properties in Arizona and New Mexico.

H. Kenyon Burch has recovered completely from a recent operation and will return from Los Angeles to Warren, Arizona, on November 1.

Joseph William Richards, Professor of Metallurgy in Lehigh University, died on October 12. He was born in England and was brought to this country at an early age, being educated in Philadelphia and at Lehigh University, where he was appointed assistant instructor in metallurgy in 1887, and professor of metallurgy in 1903. He was the first president of the American Electrochemical Society and an author of distinction. His death is a great loss to Lehigh University as well as to American technology.

THE METAL MARKET

METAL PRICES

San Francisco, October 25

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.25
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$82
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.50

EASTERN METAL MARKET

(By wire from New York)

October 24.—Copper is quiet and easier. Lead is steady and firm. Zinc is less active but easier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Oct. 18	70.62	40.62	Sept. 12	63.96	38.98
" 19	69.25	39.87	" 19	65.14	39.56
" 20	71.50	40.87	" 26	67.68	40.96
" 21	71.50	40.87	Oct. 3	71.07	42.89
" 22	70.87	40.75	" 10	70.73	42.06
" 23 Sunday			" 17	72.97	42.57
" 24	70.12	40.12	" 24	70.04	40.52

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.06	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	....
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Oct. 18	12.75	Sept. 12	11.94
" 19	12.62	" 19	12.08
" 20	12.62	" 26	12.12
" 21	12.62	Oct. 3	12.21
" 22	12.75	" 10	12.64
" 23 Sunday		" 17	12.80
" 24	12.75	" 24	12.69

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	....
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Oct. 18	4.70	Sept. 12	4.55
" 19	4.70	" 19	4.60
" 20	4.70	" 26	4.68
" 21	4.70	Oct. 3	4.70
" 22	4.70	" 10	4.70
" 23 Sunday		" 17	4.70
" 24	4.70	" 24	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	....
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	....
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Oct. 18	5.17	Sept. 12	4.70
" 19	5.17	" 19	4.70
" 20	5.17	" 26	4.73
" 21	5.12	Oct. 3	4.94
" 21	5.12	" 10	4.74
" 23 Sunday		" 17	5.12
" 24	5.10	" 24	5.14

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	....
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Sept. 27	47.50	Oct. 11	47.50
Oct. 4	47.50	" 18	47.50
		" 25	42.50

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	....
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

GROWTH OF THE ELECTRICAL INDUSTRY

Speaking at the Harvard Club recently Merle R. Griffeth, of the General Electric Co., stated that $1,000,000,000 new capital is needed each year, $3,000,000 per day, $125,000 an hour, for generating, transmission, and distribution equipment by the electric lighting industry of the United States. If capital for customers' lamps, motors, appliances, and for wiring houses and factories is considered, twice this sum will be required.

The electrical industry is less than 40 years old. It doubles every five years. Five dollars of new capital is required for every dollar of new business. Business in electrical merchandise was two billion dollars in 1920. There are 21,000,000 homes in the United States, 7,000,000 are wired and 14,000,000 are prospects for $750 each in wiring and electrical merchandise. The value of washing-machine motors in 1912 was $7,000,000, in 1920, $50,000,000.

The invention of the mazda lamp with a tungsten filament has saved the people of this country $1,195,200,000 yearly which otherwise would have been expended to produce the same amount of light from the old carbon filament lamps. These figures are based on 166,000,000 lamps manufactured in a recent year. In 1920, 270,000,000 incandescent lamps were manufactured in this country, 140,000,000 of which were automobile lamps.

The Edison Electric Illuminating Co. of Boston uses 2,000,000 lamps per year, 95% of which are mazda type. The company has 130,000 customers and there are 140,000 meters installed in a territory embracing over 600 square miles.

Twenty-nine years ago the largest power generator manufactured was 275 hp. Today there is in operation a steam turbine of 45,000 kw. equivalent to 60,000 hp. The first generator could supply 2000 incandescent lamps, the last generator, 2,500,000. The potential water horse-power of this country is 60,000,000. Only a little over one-tenth has been developed. For every horse-power developed from our streams a saving of from 5 to 13 tons of coal is made in a year. Niagara Falls represents a potential horse-power of 5,000,000, figuring at the low price of $10 per horse-power this would be $50,000,000.

The Montana Power Co. saves 2,000,000 tons of coal per year or 5500 tons daily by using water-power. On the Rocky Mountain and Missoula Divisions of the St. Paul railway, 425,000 bbl. of oil and 200,000 tons of coal are saved yearly by utilization of water-power. The electrical equipment of one battle cruiser develops 180,000 hp. Should one be anchored in Boston harbor, it could supply the entire city with power and lighting facilities. Four could supply the city of New York. The annual department store sales are $2,094,000,000. The annual liquor sales were $2,458,000,000. The electrical industry is endeavoring to obtain a good portion of the money that was formerly dissipated in the purchase of liquor.

MONEY AND EXCHANGE

Foreign quotations on October 25 are as follows:

Sterling, dollars:	Cable	3.97
	Demand	3.97½
Franc, cents:	Cable	7.43
	Demand	7.45
Lira, cents:	Demand	4.05
Mark, cents:		0.68

Eastern Metal Market

New York, October 19.

Columbus Day, October 12, was observed as a holiday here; immediately afterward a slackening in demand for most of the metals developed and still obtains.

The copper market is less active but prices are steady and a good latent demand is said to exist.

Moderate buying of Straits tin continues and prices are higher.

The lead market is quiet but steady to firm.

The tendency of the zinc market continues higher with demand good.

Antimony is inactive.

IRON AND STEEL

Producers and consumers of steel appear little disturbed by whatever prospect exists of a general railroad strike, according to 'The Iron Age'. On the one hand there has been no flurry of orders for prompt shipment; on the other hand the strike threat has not stopped buying for other than immediate delivery. Generally, the market has been quieter than in the past two weeks. Some manufacturing consumers of pig-iron and steel who could deliver their own product by truck, in case of strike, have made an effort to ensure supplies of raw material. Perhaps in sheets more than in other rolled products, mills have been asked to expedite deliveries. Wire nails, in which the final distribution is local, have also been called for in the same way.

The belief that in some way a strike will be averted accounts in part for the generally even tenor of the market. A greater influence than the strike-threat itself is the practical certainty of freight-rate reductions. Its effect is seen in some withholding of shipping orders.

COPPER

The market has turned quiet. There is still a good inquiry and considerable latent business, but there is by no means the activity which has characterized the past three or four weeks. Producers have sold themselves into a comfortable position and most urgent needs of consumers are supplied. Because of the prospective railroad strike there are some cases of requests for a speeding-up of shipments, but the effect otherwise has been unimportant. Prices for electrolytic copper are steady at 12.75c., New York, or refinery, or 13c., delivered, though a week ago most sellers were asking and obtaining 12.87½c., New York, or 13.12½c., delivered. Sales to foreign countries continue satisfactory, with the Far East the principal buyer. One seller reports a substantial amount of prospective business before him which will probably materialize as soon as the problem of the railroad strike is settled.

TIN

For several weeks now there have been substantial sales of Straits tin, with consumers purchasing a large portion; this movement continues. On the whole, the week has been a quiet one with sales confined to two days—Thursday and Friday. On the former day about 100 tons of spot Straits was sold at 27.25c., New York, and on the latter about 150 tons of future shipment at 27.75 to 28c., mostly to consumers in both cases. On October 13 there was some business in tin, ex-steamer at dock, at 27.12½c., and there were buyers but no sellers of far-future shipment at 27.62½ to 27.75c. One difficulty in getting future-delivery tin is the fact that London houses are ready buyers and take all they can get. Spot Straits yesterday was quoted at 28c., New York. The London market was strong with spot standard quoted at £157 5s., future standard at £159 10s., and spot Straits at £157 15s. Arrivals thus far this month have been 1895 tons with 3430 tons reported afloat. Shipments from the Far East to all countries for October 1 to 15 have been 2235 tons.

LEAD

The market is featureless as to developments but a steady demand continues with prices firm. The leading producer continues to take business at 4.70c., New York and St. Louis, while independents are asking a slight premium in the East but selling at around 4.50c. in the West.

ZINC

The market continues strong and moderately active with prices advancing almost daily. Nearly all producers have sold their October output or as much as conditions warrant. This, combined with the fact that they are not generally drawing on stocks made at high prices, is the cause of the present continued stiffness. Prime Western for early or 30-day delivery is quoted at 4.67½ to 4.70c., St. Louis, or 5.17½ to 5.20c., New York, with business done at the lowest levels. There is a large inquiry for brass-special zinc, aggregating about 3000 tons spread over several months delivery, but none has been contracted for yet.

ANTIMONY

The market is quiet with wholesale lots for early delivery quoted at 4.90c., New York, duty paid. This could probably be shaded on desirable business.

ALUMINUM

There has been no change, the leading producer quoting 24.50c. f.o.b. plant for wholesale lots of virgin metal, 98 to 99% pure, with the same grade obtainable from importers at 17 to 18c., New York, duty paid.

ORES

Tungsten: The market is stagnant and prices are nominal at $2.75 to $3 per unit for Chinese are and $3 to $3.50 per unit for South American wolframite.

Molybdenum: There is no activity and quotations are nominal at 48 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: An absolute lack of demand, because of previous contracts and large stocks, renders quotations nominal at 20c. per unit, seaboard, for high-grade foreign ore.

Chrome: One seller quotes foreign chrome ore at $20 to $26 per net ton, c.i.f. Atlantic ports, nominal, and depending on analysis.

FERRO-ALLOYS

Ferro-manganese: Both British and American products are quoted on a basis of $58.35, seaboard, and there is almost no business. Attempts are being made to solicit a group of buyers to take British alloys at $50, seaboard, and it is stated that American makers have expressed a willingness to meet this, if consummated.

Spiegeleisen: There have been sales of about 400 tons of 19 to 21% alloy at $26 furnace, for delivery this year. Quotations range at $25 to $26, furnace.

Ferro-tungsten: There is very little demand. The domestic product of standard analysis is quoted nominal at 40 to 45c. per pound of contained tungsten, f.o.b. plant, while the foreign alloy is held at 50c., duty paid, seaboard.

Ferro-silicon: The 50% alloy is quoted at $60 to $65 per ton, delivered, and there have been moderate sales.

Ferro-chromium: The regular 60 to 70% alloy, containing 6 to 8% carbon, is quoted at 11c. per pound of contained chromium in wholesale lots, while the 4 to 6% carbon alloy is held at 11 to 12c., both f.o.b. plant.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE 'LITTLE TUGGER' DERRICK

Necessity recently fathered the invention of an inexpensive derrick, and at the same time showed another novel use of the 'Little Tugger' hoist.

Fire gutted the 600-ton mill of the Silver King Coalition Mines Co. This mill concentrated the ores from the company's mines, which are situated at Park City, Utah, about 35 miles south-east of Salt Lake City.

Two 'Little Tugger' hoists were used in the construction of the derrick for clearing away the debris to make room for the new mill which is now being erected. This derrick was used to lift all of the heavy material. The hoists are small, compact drum-hoists operated by compressed air or steam. Originally they were used in the company's mines; they were first put on the market as portable mine-hoists.

Following is a description of the derrick and the work:

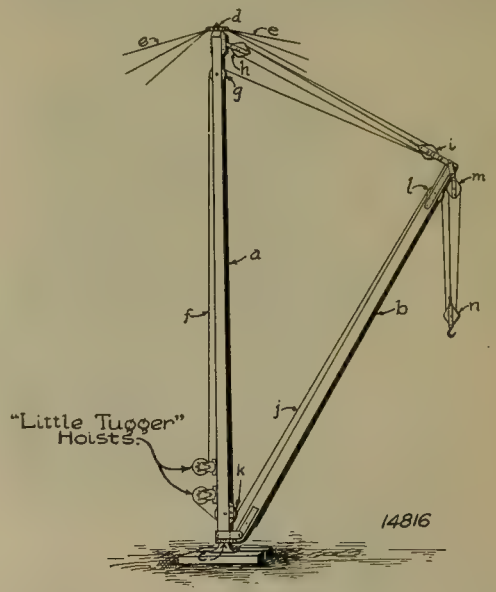
Improvised Derrick, Lifting Half of a Marcy Mill

The mast a and the boom b were both made from telegraph poles. The mast is carried at the foot by the pivot d, held by the guy-ropes e. The boom is pivoted at the lower end of the mast. The rope f is connected with the upper hoist and passes over the sheave g at the top of the mast and through pulley h at the mast-head and i at the bottom of the boom. This rope varies the angle of the boom.

The hoisting-rope j is connected with the lower hoist and passes under the sheave k on the mast, over sheave l on the boom and through the pulleys m and n. This is the rope which suspends the load.

The derrick is swung by hand, although another 'Little Tugger' could do this work also if it were desired. In this case the derrick would have to be furnished with a bull-wheel.

The installation photograph shows the derrick in action. One-half of a No. 64½ Marcy mill has just been lifted clear of the ground. It was used in clearing away about 90% of



Arrangement of Hoists, Poles, and Tackle to Make a Derrick

the wreckage from the fire. With the pulley arrangement shown, the derrick is capable of lifting approximately a 3-ton load. This, of course, may be varied to suit conditions.

HARDINGE COMPANY PUBLISHES A NEW CATALOGUE ON PULVERIZED FUELS

A bulletin entitled 'Pulverized Fuels' has just been published by the Hardinge Co. This bulletin is known as the No. 9 Catalogue. The Hardinge conical mill, although only recently applied to this work, has been fully demonstrated as a most satisfactory unit for pulverizing solid fuels. This bulletin is divided into three main sections: the application of pulverized fuel to various burning problems; the principle of operation of the Hardinge mill; and a discussion of the application of the Hardinge system for pulverizing fuels.

Under the first heading three principal causes are mentioned for the advance in the use of this class of fuel in the last few years. The reasons are:

a. The increased efficiency of combustion.

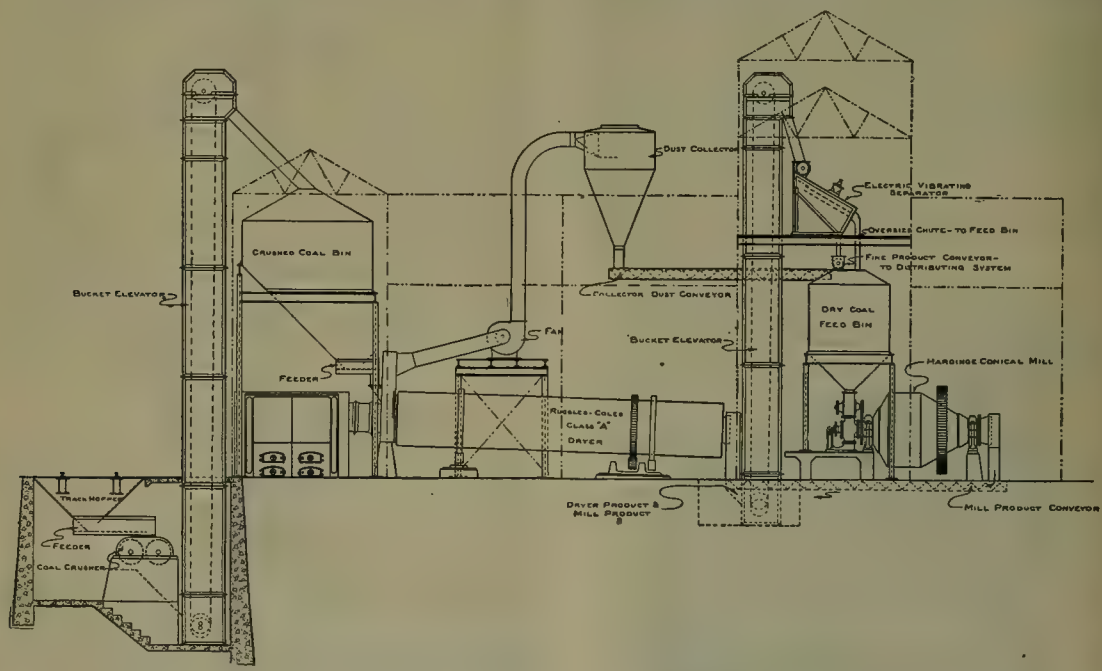
b. The utilization of fuels which would otherwise be wasted or be inefficiently burned.

c. Flexibility of operation and ease in handling, making it possible to control the burning within a wide range on short notice.

In the general discussion of pulverized fuel where the Hardinge system is used, emphasis is laid upon the point of 'sparking' during the burning process. The book emphasizes the point that when coarse oversize of from 65 to 150-mesh, depending upon the character of fuel, is eliminated, 'sparking' ceases, and when this oversize is eliminated by a satisfactory means, it is not necessary to grind to a degree of fineness which was at one time thought necessary.

Under the head, 'The Hardinge Mill', the general principle of grinding is discussed, with special reference to stage-reduction, elimination of the fine particles as soon as produced, and the proportioning of energy to the work required. The different types of Hardinge mills and the details of their construction are also discussed in this section, and special reference is made to the advantages of the conical mill when used for pulverized fuels of widely different character.

Under 'Pulverized-Fuel Installations', a complete pulverized fuel-plant is outlined, which includes the feeding of the coal from the track hopper to the crushers, dryers, mill, separator, and distribution system. There is also taken up different arrangements of the mill and separator which would be used according to the special requirements. In addition, there is given a table showing the general dimensions of the different sizes of Hardinge mills, so that it is possible to make a rough estimate of the floor-space required for each unit. The accompanying illustration shows a typical arrangement of a coal-pulverizing plant using the Hardinge system.



Typical Arrangement of Coal-Pulverizing Plant with Hardinge Mills

A BRONZE WITH 50% STEEL CONTENT

The American Metal Products Co., of Milwaukee, which has for the past six years been engaged in producing aluminum-bronze castings of approximately 84% copper, 10% aluminum, and 5% iron, has successfully blended another alloy which will be placed on the market immediately upon the completion of its new 80 by 220-ft. foundry, and as soon as proper electrical-melting equipment is installed. Work is now progressing on the building. The analysis of the new 'Ampco' bronze is approximately 5% aluminum, from 13 to 50% steel, and from 43 to 70% copper, together with necessary amalgamating alloy. This new bronze is bright yellow in color, possessing a tensile strength of upward of 68,000 lb. per square inch; has a scleroscope hardness of from 28 to 45 points dependent upon the grade produced; pours readily, and is free from blow-holes and oxides. It is readily forged, drawn, or rolled; can be welded with either acetylene or electric process, and can be cut with a welding tip. It machines more freely than cold-rolled steel; readily takes on a very high polish and is acid-resisting to a marked degree. It solders as readily as steel.

Its specific gravity is 7.43, making it from 20 to 25% lighter in weight than ordinary bronzes. It has splendid qualities as bearing and bushing material. A number of bushings being installed on tests, are being run absolutely dry. Other bearings, lubricated, have had upward of a month's service in places where ordinary bearings break down in ten days, and show no marked signs of deterioration. Because of the low price of the steel in this composition, the new metal will naturally sell for a price less than the price of ordinary bronze in either pigs, billets, or casting form.

Bulletin 56-X, 'P & H Excavating Equipment', is the title of a new publication of the **Pawling & Harnischfeger Co.** This booklet summarizes the achievements of the P & H line in road-building, in general excavation and in all phases of engineering activity in which earth handling is a prime factor. The P & H line ranges from the heavy-duty type of machine used in the reclamation service to the compact back-filler for closing trenches. Bulletin 56-X contains records and illustrations of the actual performance of P & H excavators under widely divergent conditions of service and application, and in the varying climate and topography of different sections of the country.

The firm of J. Santos, Lda., of Lisbon, has been appointed exclusive agent for the **Novo Engine Co.**, of Lansing, Michigan. Its territory will include the whole of Portugal.

Mining and Scientific Press

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T. A. RICKARD, ... Editor

IN this issue we publish another article, on mine-sampling, by Mr. Morton Webber. This one saw the light elsewhere six years ago, and we re-print it because so many requests have been received for copies of it in its original form, now out of print, in 'The Mining Magazine'. We asked Mr. Webber to revise it and to add to it; this he has done. In a later article, entitled 'The Combination Method of Mine-Sampling', appearing in our issue of February 28, 1920, Mr. Webber suggested a remedy for the correction of the latent errors, dealing with specific cases within his own experience. Referring to the article in this issue, we may say that the second example quoted by Mr. Webber is based upon the Aurora Consolidated fiasco in Nevada. We understand that Mr. Webber examined the mine and advised his clients to offer $100,000 more than the price asked for the property, provided six months were given to do the necessary cross-cutting mentioned in the article. The additional time was refused and the property was acquired by others. In the sequel it was proved that the additional six months for exploratory work was worth $100,000 in a deal of such magnitude.

AN engineer, after visiting one of the large copper mines in Chile, aired his views in our columns recently as to the reasons for the heavy turn-over of American officials on South American properties and the frequent rupture of contracts between employer and employee. He maintained that men usually take positions abroad because the life at home lacks something that can be obtained by going farther afield; in some cases it is a measure of freedom they are looking for, or they need experience; in others, additional recompense is the deciding factor. A few migrate thoughtlessly, giving no heed to what will be required of them. The average young American mining engineer is peculiarly situated; he can get, in the United States, all the experience in mining and metallurgy he needs; in many cases if he goes abroad he misses the hundred and one advantages of home life; and, unless the normal rate of pay is unusually high, he is inclined to think that he has a grievance. The conclusion reached in this particular instance was that the company in question appeared to have done everything possible to ensure that their men were contented and satisfied; in those cases where failure had resulted, the cause was shown to be due to temperamental influences over which the officials have little or no control. These conclusions are endorsed, in the current issue of the 'Professional Engineer', by an employee of the Chile Exploration Company, the corporation on which our contributor made his comments, and who prefaces his remarks by stating that he has received a 'square deal'; the company, he maintains, tries to give its employees all they can justly ask. He then puts several pertinent questions to those who contemplate taking a position abroad. Aside from how the company may treat you, he asks, what pay you are to get, and other like considerations, will you be contented in the place in which you are to live? Will you pine for Forty-Second street and Broadway? Will you miss the city life? If you are married, will your wife be contented? This question is emphasized as one of vital importance. How long do you intend to stay? The employee gains little and the company loses much as a result of abbreviated periods of employment abroad. Too many of the dissatisfied ones—and travelers on the west coast of South America meet such men frequently, although less frequently than formerly—have been hasty in going abroad.

VARIETY and interest continue to characterize the contributions to our discussion columns. Mr. A. J. Bone calls attention to the fact that the blast-furnace still merits recognition for the efficient and economical treatment of copper ore; he emphasizes the feasibility of smelting sulphide concentrate in the blast-furnace after preliminary nodulizing. The respective merits of reverberatory and blast-furnaces have been the subject of much discussion; the adherents to reverberatory practice might be inclined to retort that it is the exception that proves the rule. Mr. Bone is right, of course, when he says that the issue is "between direct smelting and concentration". Mr. Ernest Gayford, of Salt Lake City, discusses the relation between the amount of lime added and the extraction of gold and silver by cyanidation. An excess of such alkali has been blamed by many metallurgists as a cause for the re-precipitation of gold; but the subject is one on which it would be dangerous to generalize, for conditions vary to an amazing extent, and seldom are two ores or two working cyanide solutions exactly alike; neither are operations duplicated other than in exceptional instances. The figures given by Mr. Gayford appear to offer conclusive proof as to the ill

effects of an over-dose of lime; nevertheless, we would venture to suggest that the better plan would be to estimate, by experimentation or from empirical data, the degree of protective alkalinity in the solution that corresponds with efficient extraction, and to maintain this uniform by means of frequent testing and by regulating the addition of lime in accordance with the results. It is not invariably the amount of lime that is added that affects extraction but the resulting alkalinity of the solution, and this is liable to vary hourly as a result of changes of conditions. Mr. R. B. Brinsmade makes some interesting comments on the question of the exemption from tolls of American ships passing through the Panama Canal. Mr. A. H. Jones replies to Mr. Algernon Del Mar on the subject of the flotation of gold and silver, making pertinent comment on the respective results of experimentation and practice. Gold and silver that have been ground finely appear to be amenable to the flotation process, but to us it seems that the field of application is a very limited one, when comparison is made with results being obtained by alternative methods. Nevertheless, concentration often is a necessary preliminary to another and more extractive form of treatment, so that research and investigation are justified. Mr. A. W. Fahrenwald, who recently contributed to our columns a paper on surface-energy and adsorption in flotation, replies to comments made by Mr. A. C. Halferdahl. A better understanding of the fundamental theory underlying the flotation of mineral is to be desired, hence we welcome further discussion on this interesting subject. A correspondent, who prefers to remain anonymous, takes issue with Mr. Paul R. Cook as to the respective abilities of the so-called practical man and the proficient writer to convey technical information in a concise manner; he maintains that conciseness is not a distinguishing feature, much less the monopoly, of the so-called practical man.

The Futility of War

In our last issue we reviewed Mr. Norman Angell's book, 'The Fruits of Victory'. This book ought to be read by every thoughtful man, for it is a sincere and reasonable statement of the conditions produced by the recent war and is an effective sequel to the author's previous volume, 'The Great Illusion', in which he argued that war in the modern world was a gigantic futility. He pleads for the co-operation of the nations in logical recognition of their interdependence, and insists earnestly that to fight among themselves, with the intensity permitted by modern methods, is suicidal. We in this country know something about war, but not nearly so much as the less fortunate peoples across the water; the Great War drew us into it, but our participation was brief and we were spared the loss of life, the horrors and the humiliations, the cruelties and the destructions that seared the face of Europe. Nevertheless, most of us have some imagination and have read enough on the subject to receive with sympathy such a book as Mr. Angell's, in which the dire effects of a perverted nationalism are set forth in plain and convincing language. The dry eloquence of statistics will be additionally impressive. During the four years of the Great War the loss of life, in soldiers only, not civilians, was 9,980,000, or, in round numbers, ten million lives. This does not include the millions of civilians that were killed or that died of disease and starvation. Our Civil War took a toll of 700,000 lives and the Franco-Prussian war only 184,000. Warfare has ceased to be a game between small armies of professional soldiers; it is a fight to the death between whole peoples. The loss of money in the Great War is estimated at 186 billion dollars; it increased our national debt from 1028 to 24,974 million dollars; it increased that of Great Britain from 3485 to 39,314 million dollars; and it increased the debt of France from 6346 to 46,025 million dollars. All the big wars of the world between 1793 and 1910 are estimated to have cost only 23 billion dollars, according to Mr. Will Irwin, whose book 'The Next War' is, as its sub-title states, an appeal to common sense. In a little over four years the warring nations spent eight times as much as in the preceding 117 years, and that does not include the value of private property that was destroyed nor the value of the human lives that were obliterated. According to a recent statistical valuation, an average human being in this country is worth economically $5800. Again the figures are staggering, if we multiply even a much smaller unit-value by the fifteen millions, soldiers and civilians, who were destroyed by the Great War. Nevertheless the reality of the loss is being brought home to most people more by taxation than by statistics. Of the actual expenditures of the United States during the fiscal year 1919-1920, no less than 93% of the total national revenue went to pay for past and future wars; the existing army and navy absorbed 38%, and payments on account of past wars took 55% of the entire revenue. Even the least thoughtful of citizens is beginning to appreciate, through his pocket-nerve, what war means to him. The United States spent $826,337,939 for military (army and navy) purposes in the fiscal year that ended on June 30, 1921. For the succeeding fiscal year appropriations of $830,000,000 have been made. In forty years, at this rate, we shall have spent 33 billion dollars, which is equal to the whole amount of the reparation that Germany is compelled to pay during the same period. Meanwhile the Germans are saved the cost of an army and navy, and can devote themselves entirely to productive industry. Thus the victor pays, as well as the vanquished, and in the end no one gains. The conclusion is inescapable. Nor is the cause of war the lust for territory or spoils, as in the olden time; our modern warfare is the outcome of a senseless exaggeration of a sentiment that is worthy if disciplined; it is the consequence of an insane nationalism, which ignores the fundamental fact of the interdependence of the nations of the earth. That is Mr. Angell's chief argument. As religious bigotry and sectarian vindictiveness have given place to tolerance in matters of

spiritual belief, so the nations must learn a larger generosity and a saner forbearance in their political and economic dealings with each other. The love of one's native land should not necessarily be accompanied by a suspicion or hatred of other lands. If we do not behave ourselves, life on this planet will become intolerable. The next war, which none of the great Powers can escape, if the idea of disarmament be not accepted, will involve losses in life, money, and happiness even more tremendous than the recent Armageddon. The possibilities of death-dealing machines, of attack under water and in the air, of bombing and poisoning, stagger the imagination. The horrors of the dark years, 1914-1918, are but a suggestion of those that must be expected when next the nations join in the death-grip. What would a dweller on Mars think of the inhabitants of this planet if he saw our antics? Humanity—particularly the part we denominate 'civilized'—is like a shipwrecked group of people on a small island in mid-ocean. The island is infested with wild beasts and plagued with fevers; without organized cultivation it will not produce sufficient food for the castaways, and it has a climate that requires them to build shelters; even the supply of fresh water is inadequate unless they unite in sinking a well or in building a reservoir. What would we think of these unfortunates if they were to disagree among themselves continually; if they classified themselves into blondes and brunes, and fought against each other under these colors; if the men quarreled with the women; if the tall fellows joined to kill those of short stature? We would dub them lunatics. If then they refused to join in building shelters, and in providing themselves with a sure supply of water; if they made no joint effort to prevent disablement from malaria; if they could not agree how to repel the wild beasts of the island? We would consider them worthy of the fate that surely would befall them. Do we belong only to the genus *homo* or are we entitled to sub-classification as the species *sapiens?* We tamed the brother of the wolf so that he became the guardian of the flock; shall we confess an inability to tame ourselves? Of what use is all our progress in the arts and sciences if we revert to the instincts of the jungle?

Cyaniding Pyritic Ore

In so far as contributions to current technical literature are concerned, the presidents of engineering societies usually rest on their laurels. Not so, however, Mr. F. Wartenweiler, the newly elected president of the Chemical, Metallurgical, and Mining Society of South Africa, the notice of whose preferment appears in the same issue of the society's 'Journal' as does an excellent paper on the distribution of gold in the classified products of the ores mined on the Witwatersrand. A transition from an oxidized to a sulphide zone in gold-mining operations is usually inevitable. The problem of treating successfully a low-grade sulphide ore by wet metallurgic methods is one of world-wide importance; hence Mr. Wartenweiler's paper is of more than local interest. In view of the lack of detailed information and the urgent need for knowledge on the subject, the investigation described was commenced several years ago to determine the distribution of gold in the products into which the comminuted ore is classified after amalgamation. In the tests described by Mr. Wartenweiler, flotation was used to separate the pyrite from the gangue. Various oils were tried, the combination finally adopted being one of wood-tar and turpentine, the circuit being acidified by sulphuric acid. A clean separation resulted, as shown by the extremely small amount of sulphur in the resultant tailing. Flotation was adopted as a means of obtaining the data required, not for the purpose of developing a method that would be suitable for the concentration of the ore.

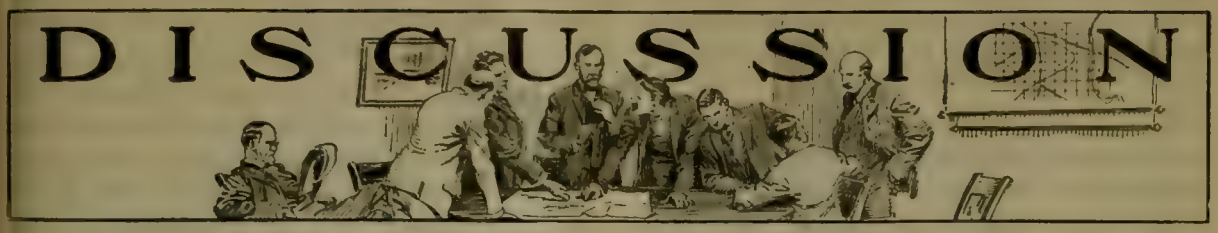
Flotation was carried to an extreme in the first test, in order to ensure a clean, pyrite-free tailing. It is interesting to note that although the concentrate in the slime, amounting to about 5% of the weight of the slime, originally assayed $22 per ton, it was reduced by ordinary cyanide treatment to $1.30 per ton. The clean gangue in the slime originally assayed $0.60, and left the plant containing $0.12 per ton; it contained 60% of the total gold that was discarded in the slime. In the second series of tests a clean mineral froth was desired, the object being to produce a gangue-free concentrate. In this case the results showed that the concentrate from the slime contained $32 per ton and represented 2.23% of the total weight; after cyanide treatment it assayed $1.20 per ton. On the other hand, the slimed gangue with some pyrite, representing 97.77% of the weight, assayed $0.90 before cyanide treatment and $0.13 afterward. In this case the silicious portion contained 82.9% of the total gold in the slime residue. In the next series of tests the pulp going to the cyanide plant was analyzed before classification. The gold was found to be distributed as follows: free, 37.5%; in sulphide, 51.4%; in gangue, 11.1%. After classification the sand charge assayed $2.90; after leaching it assayed $0.44 per ton. A test on the material before and after cyanide treatment was made to determine, in each case, the proportion of encased gold present; the aqua regia method was used. If an estimation of this character be reliable, it would appear that the cyanide solution penetrates the particles of ore and dissolves the encased gold; for the amount of gold that was soluble in aqua regia in the residue amounted to 93.2%, whereas the amount similarly soluble in the charge amounted to 89.7%. An amalgamation test on the sand showed that 19.4% of the gold was free, an amount that was increased to only 32% after a sample had been ground to pass a 150-mesh screen. It is argued, with logic, that if dissolution by means of aqua regia is analogous to dissolution by cyanide solution, no treatment that necessitates further grinding of the gangue beyond that required by leaching practice is necessary or justified.

An additional interesting fact was disclosed by an analysis of the distribution of the gold in samples that

were taken before and after leaching. Although only 9.7% of the total gold ($3.08 per ton) in the charge was found associated with the gangue minerals, an analysis of the residue ($0.50 per ton) showed that the proportion had increased to 26%. In many quarters it is considered impracticable to leach efficiently a charge of fine sand and slime. The detailed figures given in Mr. Wartenweiler's charts in regard to the results obtained by leaching a pyritic ore are of exceptional interest. In the case of a typical charge it was shown that 60.1% would pass a 90-mesh screen. The distribution and extraction of gold from the various sizings are given; valuable information can thus be obtained as to the results of the cyanidation of a mass comprising pyrite and gangue. Thus, in a typical charge of sand of an average assay-value of $2.91 per ton, it was found that $2.35 of this was in the pyrite and $0.56 was in the gangue. The residue averaged $0.343 per ton, of which the pyrite contained $0.246, and the gangue, $0.097. If these two materials were being treated in two different ways, and in different parts of the plant, a comparison could be used to emphasize the absurdity of quoting extraction figures without taking into consideration the original assay-value of the material; for from the pyrite the extraction amounted to nearly 90%, whereas from the gangue it amounted to under 83%. It is interesting to note that the extraction, by leaching, of the gold in the minus 200-mesh concentrate amounted to no less than 94%. This is proof, not only that raw sulphide concentrate can be treated by simple cyanidation, but that a proportion of the finest material can be leached efficiently in a gravity-percolation vat; even the gangue slime (−200 mesh) showed an extraction, during leaching, of over 81%, although the original material assayed only $1.45 per ton. The results indicate the importance of the fine grinding, previous to leaching, of the sulphide in the sand. This is the concomitant of operating secondary crushers, such as tube-mills, in closed circuit with classifiers. Whether the cones in use on the Witwatersand are sufficiently delicate to ensure the proper division is open to question. They possess the essential advantage of a capacity that is commensurate with the magnitude of operations; but a field would appear to exist for the introduction of mechanical classifiers of American invention and development, for the efficient treatment of at least a part of the pulp, so that the pyrite might be removed and returned to the tube-mill for re-grinding.

Mr. Wartenweiler's paper has supplied a need for definite information as to the practicability of leaching fine material, as well as in regard to the results to be expected from the treatment of raw pyritic ore. Recently there has been a tendency among metallurgical reformers on the Witwatersrand to revive the contention, of a small but radical group, that gravity leaching should be abolished, in favor of fine grinding and filtration by pressure or vacuum, regardless of cost or of loss of gold in the residue. Mr. Wartenweiler's paper offers evidence that such a change would be unjustifiable and stupid. Sliming may be essential elsewhere; all-sliming plants are operating in many parts of the world with signal success; but neither of these facts can be used logically to justify a change in one of the fundamentals of Rand practice. Extravagant claims are being made as to the saving that may be expected by abolishing amalgamation and adopting all-sliming; but what are the facts as to present losses and costs? Take, for example, the figures of the mines under the management of the Corner House group, which controls nearly half the output of the Witwatersrand; these show that the loss of gold in the residues last year was under 27 cents per ton, after a combined amalgamation-cyanidation treatment. The Government Areas company's residues averaged about 38 cents per ton. It is clear that little or no saving can be effected in this connection without incurring heavy charges for fine grinding and treatment. A typical example of present costs is seen in the case of the Government Areas, whose total expense for sorting, crushing, milling, amalgamating, cyaniding, and disposal of residue was about 67 cents per ton last year; at the Witwatersrand company's plant it was little more than 90 cents per ton. It is inconceivable that appreciable economies would result from the introduction of fine grinding, but rather the reverse. However, the Springs company, acting on the advice of its consulting engineer, Mr. C. R. Davis, is to adopt the 'new metallurgy'. We trust that the data of metallurgical results and costs will continue to be published with the same frankness and in the same detail as heretofore. South Africa has a remarkable record as a producer of gold, thanks to the soundness of the policies of the metallurgical engineers in control of operations. In spite of the serious diminution in the total output of the metal throughout the world, the Transvaal not only has maintained the lead, but, since 1914, has contributed a steadily increasing percentage of the whole. The retention of logical metallurgical methods has been responsible to a considerable extent for this result.

Almost the whole of Mr. Wartenweiler's paper consists of charts. The figures on some of these are illegible, otherwise we might have deduced more that is interesting to our readers. Nevertheless, the information made available is of considerable value; we trust that the experiments will be continued; the publication of such data will serve to encourage the wider application of a simple yet efficient method of treating a low-grade ore, whether it be pyritic or not, and on a scale that will mean increased exploitation and extended interest in gold mining throughout the world. The metallurgical engineers and the mining companies on the Witwatersrand have been generous to a degree in the dissemination of valuable information on the metallurgy of gold; the transactions of the Society, especially during the early days of cyanidation, constitute text-books on the subject; vital data have neither been withheld from publication nor camouflaged. All concerned are to be congratulated on the results, which are reflected in the reports of those companies that have adhered to standard metallurgical practice.



Reverberatory v. Blast-Furnace

The Editor:

Sir—In your issue of September 17 there appears an article by Arthur B. Parsons describing the smelter of the Nevada Con. Copper Co. In the opening paragraphs the author indulges in some generalizations, perhaps not altogether seriously, which tend to spread the mistaken idea that the reverberatory has superseded the time-honored blast-furnace and that the latter is rapidly becoming obsolete. He says:

"If the plant is old enough there is likely to be a blast-furnace department; the probability is that it has been idle for some years, and, moreover, that the furnaces will never run again, although for some strange reason many metallurgists are loath to see these old friends torn down."

Unfortunately, the belief that the copper blast-furnace has served its time is all too common among many who are not in intimate touch with copper smelting, or whose experience and activities have been largely restricted to localities where conditions distinctly favored reverberatory practice. True it is that in certain regions, notably the South-West, the reverberatory predominates, but the reason for this should not be confused. The ascendancy of the reverberatory over the blast-furnace in these districts is the result of wide-spread application of concentration at the expense of direct smelting. Fundamentally, the issue has not been between types of furnaces, but between direct smelting and concentration. The increased production of concentrates has called for more smelting in reverberatories, this type of furnace being especially adapted to the treatment of fine material. In order to compete, the blast-furnace requires a preliminary preparation of such fine material by means of nodulizing, sintering, or briquetting. It is not improbable that improvements in the preparatory process may make of the blast-furnace a dangerous rival to the reverberatory in its own special field, if, indeed, it is not that already. The Braden Copper Co., in designing its new Caletones smelting plant, which will handle a large tonnage of flotation concentrate, decided on nodulizers and blast-furnaces rather than roasters and reverberatories.

Blast-furnaces will occupy a conspicuous place in the equipment of another large copper smelter being built in South America, that of the Cerro de Pasco Co. at Oroya, Peru. In glancing over the important modern copper smelters that have been built in the past eight or ten years, and are therefore comparatively new, one notes the following having blast-furnace equipment in whole or in part:

Calumet & Arizona	Blast-furnaces and reverberatories
United Verde	" " " "
United Verde Extension	" " " "
Katanga	Blast-furnaces only
Granby, at Anyox	" " "
British America Nickel	" " "

From the foregoing, it is evident that a plant need not be very ancient to be "old enough" to have a blast-furnace department.

A. J. Bone.

New York City, October 12.

Lime in Cyanidation

The Editor:

Sir—In conducting cyanide tests recently we found that somewhat small variations in the quantities of lime used had a marked effect upon the extraction of the gold, and we should like to know if any of your readers have had a similar experience and have been able to attribute the cause. The ore in question assayed as follows: gold, 1.205 oz.; silver, 1 oz. per ton; insoluble, 92.4%; and iron, 2.6%. It was a clean free-milling material with only a small percentage of sulphur combined with the iron. Below we give results of some of the tests:

Lime Lb. per ton	Where used	Crushing Mesh	Hours agitated	Tailing Gold, oz.	Assay Silver, oz.	Density	KCN in solution Lb. per ton
2	In agitator	65	16	0.06	0.3	3:1	2.9
4	" "	65	16	0.44	0.4	3:1	2.9
6	" "	65	16	0.71	0.5	3:1	2.9
2	" "	65	24	0.055	0.30	3:1	3.0
2	" "	65	36	0.05	0.25	3:1	3.0
5	" ball-mill	65	16	0.57	0.30	1:1	2.0
7	{5 " " / 2 " agitator}	65	16	0.57	0.30	1:1	2.0
5	" ball-mill	100	16	0.55	0.25	1:1	2.0
7	{5 " " / 2 " agitator}	100	16	0.59	0.20	1:1	2.0
2	" ball-mill	100	16	0.03	0.20	1:1	2.0
8	{2 " " / 1 " agitator}	100	16	0.17	0.20	1:1	2.0

It will be noted that the condition varied at one time was the quantity of lime and that in the last two tests a difference of only 1 lb. of lime per ton of ore made a difference in the gold extraction of $2.80 per ton, whereas the silver extraction remained constant. When 5 lb. of lime per ton was used the tailing jumped up to $11.40.

Under the heading 'Silver Cyanidation at Tonopah', A. H. Jones states* in part as follows:

"In this mill (Millers) at least the lime content is very closely watched, it having been proven not only by

*'E. & M. J.', April 12, 1913; page 767.

laboratory test but on a working scale, that extraction is very erratic, due to re-precipitation when either too high or too low alkalinity is carried. The lime is maintained between 1 lb. and 1.5 lb. of CaO per ton of solution."

Mr. Jones told us recently that while he satisfied himself that the lime caused re-precipitation, he was unable to find out the reason for this. In our case we cannot follow the re-precipitation theory because the silver extraction remained practically constant whatever amount of lime was used, while the gold extraction alone varied.

Salt Lake City, October 5. ERNEST GAYFORD.

Panama Canal Toll-Exemption

The Editor:

Sir—In regard to your various recent editorials respecting the exemption of American ships from the tolls of the Panama Canal, I am entirely in agreement with you that the Hay-Pauncefote treaty should not be broken, by putting in force this exemption, without the consent of Great Britain. But I cease to follow you when you advocate the purchase of this consent, for I fail to see that the American people, as a whole, stands to gain anything by the proposed change in the present canal policy. An exemption of American ships from the toll of $1 per ton will mean a large decrease in the receipts of the Canal; in 1918 (the last year for which I have figures) these were only 6½ millions, or less than ⅓ of the 20¾ millions required for operating expenses and the fixed charges on a capital investment of 400 millions. Of course this decrease must be made up out of the revenue of the Federal government, in addition to the deficit under the prevailing policy, so that the practical question is whether the taxpayers will gain any benefit in return for this increase of their fiscal burden.

In considering the economic effect of the toll exemption and locating the beneficiaries of the taxpayers' loss, the classes of ship-owners, shippers, and consumers naturally suggest themselves as the objects of investigation. The ship-owners fall into two divisions: those of the coastwise and those of the foreign trade. As the coastwise trade is restricted to American bottoms by law, the toll exemption cannot affect them as regards competition with foreign bottoms, for the law allows none, but only as regards their sole competitors, the transcontinental railways. As the exemption saves a dollar per ton in the cost of transport between our Atlantic and Pacific coasts, it is clear that the freight-rates to shippers can be decreased by that amount without affecting marine profits. Whether this decrease in costs benefits shippers or not depends on the preservation of competitive conditions in the coastwise trade; should ship-owners get together and agree to maintain only a semblance of competition, they could then put the dollar of saving into their own coffers. Even should this last mischance be avoided and the whole saving of the toll exemption continue to be absorbed by consumers, in the form of lessened prices for commodities, the economic equity of the whole transaction would be doubtful for it would mean the subsidy of these consumers residing near the coasts, at the expense of the nation.

In the foreign trade the toll exemption would give American ships a direct advantage in competition with alien bottoms; but here again this would be paid for out of the purse of the Federal taxpayer and would really be nothing but a ship-subsidy in disguised form. If this advantage should ever prove sufficient to run all foreign bottoms out of the Panama route, the income of the canal would be reduced to zero and the whole annual expense for its maintenance would have to be met from the Federal Treasury.

Thus, like a protective tariff, the toll exemption seems, by analysis, to be a proposal where local and special interests are to be benefited at the expense of the general public.

ROBERT BRUCE BRINSMADE.

Ixmiquilpan, Mexico, September 27.

[In the bulletin of the National City Bank we find the following: "It cannot be too strongly urged that the high purpose of limiting and eventually abolishing expenditures upon armaments, and of settling all differences that arise between countries by peaceful means, depends for realization upon mutual good-will, regard for each other's feelings and opinions, and scrupulous regard for treaty obligations." This is well said.—EDITOR.]

Flotation of the Precious Metals

The Editor:

Sir—In regard to Mr. Algernon Del Mar's article in your issue of October 8, although it has been my experience that free or native gold and silver float readily when finely ground, it is hard to understand how the K & K machine makes this recovery possible over other styles of machines.

I have found that a small test-machine will very closely approximate the larger working units if the work is carried on in a practical manner in order that all conditions of treatment as closely as possible approach the working basis. Mr. Del Mar's example that test-machine results of 41% were verified at the start of a 20-ton mill, but that altering conditions, indicated by testing, doubled this extraction, seems to disprove his contention. No doubt the same amount of practical alteration in the experimental work would have shown the same results. At least, it would have been interesting if he had tried duplicating the final accepted treatment with the test-machines. Better work will always be shown in actual mill-practice over test-work following the same procedure, owing to continuity of operation, but it will not show double the recovery. In fact, the betterment should not be great.

Mr. Del Mar's remark that an increase of the amount of froth in the rougher machines tends to reduce the tailing loss seems reasonable. Considering flotation conditions from a physical standpoint and deducing by comparison with older methods of concentration, it seems

reasonable to suppose that building up the froth to a high mineral content and only delivering the concentrate-froth as fast as new mineral is added, will tend to higher extraction, which it does.

As a comparison, if an amalgamation plate is hard or not well dressed and a particle of rusty gold, or carrying a particle of quartz, is passed over, no doubt it will not be caught. But if the plate is well dressed and has a surface of soft amalgam, the particle of rusty gold will readily be held by the bond of the metal-carrying surface.

In the flotation-cell, if the zone of froth is low in mineral content, a partly oxidized sulphide or one associated with a piece of gangue may not carry the oiling condition so as to again drop out. If, however, the froth zone is maintained at a high mineral content, these refractory particles once thrown into the froth zone will be caught and held by the bond effected by this richer froth.

A. H. JONES.

Salt Lake City, October 13.

Surface-Tension in Flotation

The Editor:

Sir—In your issue of October 8 is a discussion by A. C. Halferdahl of my recent paper 'Surface Energy and Adsorption in Flotation'. It is pointed out that the Willard Gibbs adsorption formula holds only for true solutions and that it has not been proved to be true for colloids. Experiments are under way here to ascertain to what extent it does hold for emulsions of flotation-oils and water. The formula was included in my paper with the purpose of emphasizing the relation between surface-tension and adsorption.

Mr. Halferdahl further points out that the surface-tension measurements given were made by a static method and that the measurements by a dynamic method would probably give data of greater interest. Relatively the method used is static, but actually it is also dynamic if proper precautions are not taken in making a measurement of the surface-tension of an emulsion of a flotation-oil in water. The film method also measures a changing tension, which, however, is never very far from the surface-tension at the point of equilibrium between the oil on the surface and the oil in the body of the emulsion.

A method to be of any value in constructing surface-tension concentration curves from which the amount of oil adsorbed by a mineral is determined, must measure the tension of a surface of definite known age and all measurements must be made on surfaces of this same age in order that results may be compared, or it must measure the tension of a surface at a point where equilibrium exists between the oil on the surface and the oil in the body of the emulsion.

Different methods of measuring the surface-tension of emulsions of oil and water give widely different values. Surface-tension concentration curves for a pine-oil in water by three different methods, namely, my method, the drop-weight method, and the Jaeger capillary-bubble method, are shown in Fig. 1.

Emulsions of many oils in water actually appear to reach a point where the oil adsorbed on the surface is

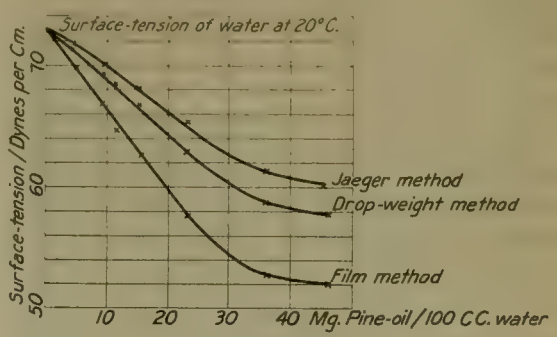


FIG. 1

in equilibrium with the oil in the bulk of the emulsion. For example, if an emulsion, in a suitable dish, be skimmed with a strip of paraffine paper and its surface-tension be measured immediately by the film method, the surface-tension of the freshly formed surface will be

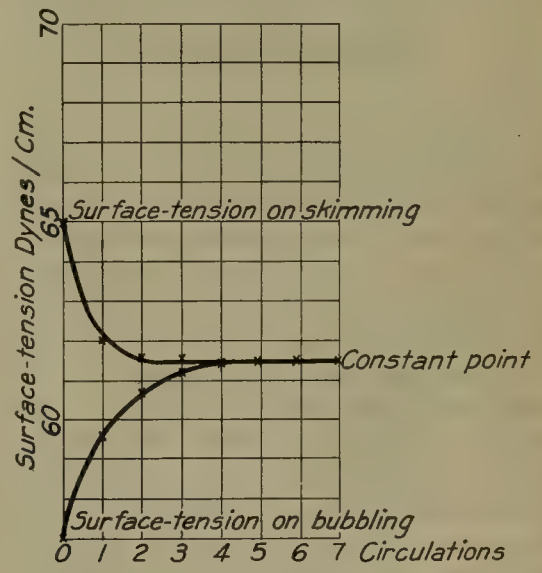


FIG. 2

fairly high. See Fig. 2. If now the emulsion be circulated* a number of times, and the surface-tension measurements made between circulations, it will be found that the surface-tension falls with each circulation to a point where it seems to remain constant. Further circulations do not effect a further lowering of the surface-tension. If small air-bubbles be blown into the same emulsion for a minute or two, the surface-tension will fall considerably below this constant point, but, on again

*The emulsion is circulated by sucking it up into a 100-cc. pipette and allowing it to discharge into a dish underneath the surface of the emulsion. This method of circulation sets the emulsion in motion without disturbing noticeably the surficial film.

circulating the emulsion, it will go back up to the constant point reached on coming down, but will not go above it.

Surface-tension measurements made on emulsions circulated to a constant surface-tension have so far been found to be most reliable. It is surprising how many little factors disturb the surface-tension of an oil-and-water emulsion.

I should like to ask Mr. Halferdahl how he accounts for the inconsistency in the second column of figures in the tabulated data showing static and dynamic surface-tensions for water and mixtures of water and sodium oleate. The surface-tension of water is given as 75 dynes per centimetre and immediately under this the surface-tension of 0.025% and 0.25% sodium-oleate solutions is given as 79 dynes per centimetre, whereas for the same two solutions, by a static method, the surface-tensions are given as 55 and 26 dynes respectively. It is hard to understand how a surface of even only one-thousandth of a second old could have a tension higher than that of water, especially in view of the low values recorded as being obtained by a static method.

Moscow, Idaho, October 11. A. W. FAHRENWALD.

Technical Writing

The Editor:

Sir—Mr. Paul R. Cook, in your issue of October 29, after associating style and literary perfection with a verbosity that tires the reader, suggests that what he terms the practical man "should give the effusions of the writer who possesses literary talent the necessary brevity demanded from an engineering viewpoint; the practical man's message should be subjected to the literary artist, who should be allowed full play whenever he can say as much in as few words".

One notes at first glance the line of demarcation drawn between the so-called practical man and the careful writer. No attitude is more unfair than the one that habitually assumes that the man who makes an effort to use words in their proper sequence and sense is impracticable, visionary, and impotently inactive in so far as the application of ideas is concerned. It has been said that careless writing indicates careless thinking. It is certain that careless thinking leads to inefficiency of action; and inefficiency of action often marks the principal distinction between the so-called practical man and the engineer who co-ordinates effort to logical theory and fundamental principle. Many capable engineers can write well; they are as efficient in practice as they are in theory. Literary ability does not infer unintelligent action.

Mr. Cook puts the cart before the horse; the so-called practical man is undoubtedly the worst offender in so far as verbosity in writing is concerned; such a characteristic marks an elementary acquaintance with literary principles; it persists for a period of time through which we all have to pass, its length depending on our own efforts to improve. The so-called practical man trying to teach the experienced and careful writer how to condense might well be likened to the burglar endeavoring to reform the minister into whose house he has broken. In any case I foresee other objections to Mr. Cook's plan, that the manuscript of writers with literary talent should be submitted for condensation to the practical man before publication. What type of practical man should be chosen for the task? Suppose, for instance, that an article summarized mining, metallurgical, and economic conditions on a large property in a foreign country; the umpire need be an authority on these subjects, else he might delete what would be of interest and profit to the majority, leaving intact only those parts that appealed to himself and to those in his own sphere of activity; or the article might deal with the validity of Kick's law, with preferential adsorption, or with the Einstein theory. Would Mr. Cook guarantee to find a practical man who could be trusted not to throw a manuscript on such subjects into the waste-basket? Everyone does not appreciate classical music; but this should constitute no valid reason for suggesting that Rachmaninoff, before appearing in public, should submit his program for revision at the hands of the 'musician' in charge of the steam-organ at the local circus; or that the composition of the jazz artist should be revised and corrected by the conductor of the Boston Symphony Orchestra, provided, however, that the result will ensure as much noise without lengthening the score.

Almost all the striving for unmistakable clarity in technical writing results in condensation; proficiency can only be acquired, in the opinion of those who are experienced, by a grinding apprenticeship to an ideal that is never attained. The average editor has at least one difficult task to perform—in connection with the condensation of the literary efforts of the average practical man. Only an insignificant proportion of the corrections in manuscripts are due to a necessity for conforming to style. The acquisition of style is mechanical; effective condensation is an art. The editor's work is concentrated to a large extent on the elimination of verbosity, the re-writing of sentences and phrases so that the concrete is not mixed with or compared to the abstract, the provision of proper punctuation to ensure clarity, and the correction of error. If there be any basis for Mr. Cook's belief that the practical man has the gift of being able to express himself clearly and unmistakably in fewer words than are needed by the experienced writer, then by all means let us have the recipe; for large numbers of students, many editors among them, are spending weary years of labor and care in an effort to gain, by self-discipline and by practice, the proficiency that will enable them to tell their stories, without possibility of misinterpretation, in a few apt and well-chosen sentences. Either literary proficiency is attained only by sustained effort, or, if Mr. Cook be correct, we are witnessing an appalling waste of time on the part of those who know of no other way to become successful writers.

ENGINEER-JOURNALIST.

San Francisco, October 31.

Errors Latent in Mine-Sampling

By Morton Webber

*In basing a mine report on expected output upon sampled areas it should be understood by all concerned that an estimate founded on sampling will still remain an estimate. Irrespective of the experience and care exhibited in the work, the valuing engineer will undertake too much if he assumes that such data embody a statement of fact. The fallibility of an approximation cannot be eliminated, although in cases it may be modified to meet practical requirements.

There is a latent error varying with the mineral nature of ore deposits that it is impossible under practical conditions to control by extreme uniformity in cutting samples and their nearness to each other. This error usually indicates a higher metallic content than shown throughout an adequate period of actual ore-treatment, affording data of results in mill-yield, plus residual contents. In the South African banket, the mill-yield plus tailing-content is from 6 to 15% short of the average indicated by sampling. In the premier lead mines of Australia the discrepancy is at least 10%. The results from four well-known gold mines show an unaccounted difference of 12%. These mines are situated respectively in Mexico, Colorado, Australia, and India.

In the valuation of a mine, conditions will generally fall under one or more of five classes. After tabulating these, as is done below, I shall endeavor to discuss each in turn. Under practical conditions many of these classes will merge and shade into each other in the same mine; they are separated here largely to facilitate explanation.

(1) Where the average metal-value is mechanically reduced, but where the unaccounted metal may be subsequently recovered.

(2) Where there exists an unrecoverable loss.

(3) Where sampling indicates a fictitiously high value.

(4) Where sampling gives an incorrect subnormal value, conclusive proof being afforded by subsequent operations.

(5) Where sampling is of no use.

(1) In narrow veins where the breaking of waste is necessary, the ore going to the mill will be reduced in grade. Even if sorting is carefully done, it is impossible to keep all the waste out of the mill, especially if the enclosing walls are soft, yielding more or less fine material. In a narrow vein it is customary to allow for this, but my experience is that such an allowance is generally insufficient. Even in veins of normal width it is usually impossible to break ore without the inclusion of some waste. In such a case the descrepancy in metallic content is likely to be considerable, owing to the fact that no hand-sorting may be employed. This discrepancy will largely adjust itself when the mine or stope is worked out, as the decreased value per ton is compensated by the greater tonnage crushed; but the valuing engineer, if wise, when computing his factor of loss, will largely disregard this; as it will be difficult to explain to those not versed in valuation that the mill discrepancy will adjust itself by a greater tonnage crushed.

(2) In mines in which filling is necessary, and also in cases of underground sorting, there is always a loss in the waste, even where boards are used. This may cause a loss of tonnage rather than of value per ton—possibly a combination of both. In either case it is a loss of marketable contents that the mine-valuer should be careful to deduct from his estimate.

(3) Where the metallic contents of ores are in sulphide form the sulphides are frequently more friable than the gangue. In consequence, the samples will contain an abnormal proportion of high-grade 'metallics'. Discrepancies of this kind are more usual in copper and other base-metal mines, but in the case of gold and silver ores, in which the metal may be enclosed in a friable sulphide, this error should be very carefully considered, as it may result in an estimation out of all proportion to subsequent results.

I quote an example from my own experience: The lode was a fault-vein in rhyolite. There was a vertical displacement of about 32 ft. resulting in brecciation, the fracturing having occurred when the rhyolite was comparatively cold. The auriferous solutions, which were post-fault, formed the cementing material. The fragments of rhyolite were almost entirely undigested. A sampling-error of about 17% existed.† The angular fragments contained no gold, and the cementing material, which was 'high-grade', was in process of rapid decomposition and when sampled broke down out of proportion to its relation in the ore.

This is an excellent example of a latent sampling-error as distinct from a mechanical error. A simple example of the latter is the sampling of a width narrower than is subsequently mined. This error is not latent, for it is due either to faulty judgment by the valuing engineer or lack of co-ordination in his views and the operations of the mine. The latent error is inherent in each sample without relation to care or judgment.

(4) Where there are two sulphides in the same ore, one hard and dense and the other soft and friable, the latter will break more easily in sampling, and therefore will be abnormally represented in the valuation. If the

*This article appeared in the 'Mining Magazine' of February 1915, and is re-printed now by request of several engineers. The author has taken the opportunity to add some examples from experience.

†As disclosed by milling blocks of ore and comparing mill-yield plus tailing-loss with hand-sampling.

major richness is in the hard sulphide the inference is likely to be unfair to the property.

Some years ago I examined a copper mine in which the ore was chalcopyrite. After carefully sampling the ore exposed, which I estimated as a mass 550 ft. long by 8 ft. wide and 300 ft. deep (the bottom of the mine at that time), my average was 4½% copper. My estimate of tonnage from this block was 440 tons per horizontal foot. Since that time this ore has been stoped. The tonnage actually mined has aggregated 130,000 tons, or 430 tons per horizontal foot. Such a close estimate clearly proves that the mass that was removed was practically the same as was estimated in my examination. It is evident that the inclusion of waste and pillars did not vitiate the comparison. The subsequent treatment of the ore proved by estimate of 4½% copper to have been about ½% low; or an error of over 11% on the total copper-value. It is my opinion that the unavoidable breaking down of an excessive proportion of the friable ore of lower grade was responsible for the error. For this there is no preventive under practical conditions. It is only possible to remedy the discrepancy by the addition or subtraction of a factor as the outcome of experience. A discussion of the shortening of the distance between sample-cuts, so often the last resort of an engineer to promote accuracy in difficult cases, has no bearing on the matter.

(5) There are mines in which the valuable minerals occur in bunches. Under such conditions no confidence can be placed in an assay-map, even though an unusually close sampling interval may have been adopted. A level may pierce a certain number of enrichments, which would be represented on the sampling record. Had the horizon of the level, however, been 30 ft. higher or lower, the number of enrichments pierced might be out of all proportion to the true average. In a mine of this type an attempt to estimate the contents of a block of ore would be absurd. The nature of the ore occurrence would demand a veritable network of levels and rises so close together that all hope of profitable operations would be killed by the cost of development. Many mines exist in which an assay-plan would show the majority of samples to be unprofitable, yet the subsequent exploitation has afforded conclusive proof to the contrary. This does not refer only to precious-metal mines. The base-metal mines of Missouri and the copper mines of Lake Superior are analogous. Under such conditions the only reliable valuation would be based upon an authentic record of the past yield, checked by competently selected representative shipments of the remaining ore.

All this goes to show the great care that should be exercised by an engineer in forming an opinion concerning the accuracy of another engineer's examination. There are many instances where an engineer has attempted to check a former examination by re-sampling a number of cuts. I am aware of several cases in which an engineer has been employed to check the work of another, and because he could not check a selected number of sample-cuts he condemned the mine; and without reason cast a slur on the careful work of a fellow engineer.

Some time ago I was employed to report on a gold-silver mine. It had been examined not long before my arrival by another engineer acting on behalf of the vendor. It was necessary to sample the floor of part of the lowest level for a distance of 200 ft. The ore had been stoped above. There was about 18 in. of broken decomposed material in the level-bottom. The former engineer had sunk pits about 2 ft. deep, at intervals of every 10 ft. As the blasting and cutting of a fresh series of pits would entail considerable time, I decided to re-sample the old pits, after carefully cleaning and blasting a new surface. In both cases we sampled over 5 ft., the width between timbers. I here give the results of our sampling. The former engineer's results I tabulate with mine, for each of the 20 pits. My results are marked W, whereas those of the other man are marked X.

Number of pit	Sampling by W	Sampling by X	Number of pit	Sampling by W	Sampling by X
1	$11.25	$15.50	11	$30.28	$25.50
2	8.56	10.75	12	35.50	25.18
3	15.75	12.15	13	50.00	45.12
4	15.52	14.25	14	18.23	23.18
5	9.25	5.25	15	20.25	18.75
6	26.50	17.20	16	13.16	15.50
7	5.30	10.80	17	12.76	18.20
8	26.20	30.83	18	8.18	10.50
9	18.40	25.25	19	20.50	18.00
10	15.30	18.15	20	5.15	7.75

It is at once noticeable that in no instance are our results even reasonably close. The samples individually, at best, only demonstrate pay-ore; this is all they seem to have in common. In checking a few selected pits, our results would have indicated a wide discrepancy; this might have thrown discredit on the entire work of the other engineer. That we are both equally correct is indicated by the average of our total results, namely, $18.30 and $18.29; both samplings were over a width of 5 ft.; these are facts that cannot be overlooked. They prove that, where sulphides are sampled, detailed comparisons are unreliable; they demonstrate that a fundamental factor in the use of sampling data is the law of averages; they show that decreasing the interval and taking more samples is not the remedy, because the error is latent in each sample. Had I sunk fresh pits at 5-ft. intervals and re-sampled my own work I am satisfied that the results would have varied just as much; certainly the final result could not be closer. In checking and comparing the sampling of the same mine by different engineers the proper use of averaging should be confined as far as possible to the comparing of underground areas. The comparison of samples, each to each, is unimportant.

In my judgment, in analogous cases, if it be impossible to get individual samples to check, there is a strong probabality that there will be a considerable discrepancy between the sampling results and the subsequent mill-feed. Such has been my experience. In the case above, although it might seem that the other engineer and myself could be proud of our ability as mine-samplers, I really think that we only succeeded in making the same error. The discrepancy between mine-sampling and mill-

ore in this case would probably not have been less than 10%.

As an example on the borderland between latent and mechanical errors I may refer to a large gold mine in Nevada. It illustrates the danger of underestimating the native intelligence of the 'old-timer' in the search for ore. It also may stimulate the sixth sense of the valuing engineer in detecting a 'joker'.

The mine was developed to a stage where a large tonnage of low-grade ore was exposed; on the strength of which a large mill had been erected. Shortly after the completion of the mill the owners became financially embarrassed through other enterprises, and they decided to sell the mine; whereupon the property was purchased by a large company. The engineers of the buyer estimated a large tonnage of low-grade ore that, in view of its magnitude, was expected to be profitable. Shortly after milling commenced the mill-feed dropped to the cost line and all attempts to operate at a profit proved futile. A search for the cause disclosed these facts:

The property had been developed by the 'old-timers' along one side of the deposit, the width of the vein being several times that of the drift. Cross-cuts had been driven to the other wall, in order to ascertain the full width. The sampling of the cross-cuts indicated that all the vein was profitable ore. An investigation showed that the gold of the large vein was contained in small 'willow' veins within, and at rigth angles to, the large vein. When the faces were fresh and clean the old-timers had observed points of recurring congestion of the willow veins. At these points the cross-cuts were driven. When later the mine was sampled the openings had become covered with dirt; this prevented the engineers for the purchaser from detecting the peculiar character of the deposit, and they assumed that the sampling of the cross-cuts would represent the mass as mined. The milling of a few blocks of the orebody showed that the sampling was 50% too high; and a heavy loss had to be faced, for the mine had been sold for cash.

Constructive criticism of the work of these engineers is pertinent in order to avoid a repetition of the mistake. Experience is largely built on mistakes.

The cross-cuts were not driven at regular intervals. An examining engineer should always be careful to investigate the reason for placing cross-cuts at irregular intervals if the sampling of the cross-cuts is to form the basis of an estimate of the ore available. It is better business to offer a larger sum for a mine in order to get additional time to obtain complete information, by extending cross-cuts into untested blocks of ground, than to buy the mine for cash. My experience has been that if a vendor will not give a reasonable extension of time when offered, say, 10 to 20% more than he is willing to take for cash, then it is better to profit by the vendor's inside knowledge of his own mine and to drop the business. Reputations are easier lost than made.

I would also emphasize the other feature suggested by this example, namely, the covering of evidence that was obvious to the old-timer when the faces were fresh. Dirt covers underground surfaces rapidly. Many mines would look very different if some inexpensive means could be devised to give their entire exposures underground a good washing, so that the ore-occurrence could be studied and the rock-structure could be easily observed. If their 'black but comely' appearance were removed, some unfortunate experiences with such mines would be avoided.

It is impossible to tabulate the percentage of error under the relative heads discussed and to apply the results in specific cases. The engineer must use his own judgment in the examination of a mine. What has been written is intended to enable him to form a conclusion of sound premises based on given conditions. In most cases sampling will over-estimate operating results; the amount of error will vary from 5 to 25%. In the majority of cases the error is about 12%. Examples giving sub-normal results do exist, but they are in the minority; and before any improvement on the mine-sampling can be anticipated these favorable facts must be thoroughly understood.

During an address on the relation of economic geology to the general principles of geology, before the Society of Economic Geologists, R. A. F. Penrose, Jr., stated that many geologic phenomena have been utilized by mankind both long before and long after their scientific significance was known. Thus prehistoric man often lived in caves of splendid proportions without a conception of how these abodes were formed, until geology, many centuries or even thousands of centuries later, demonstrated their origin. The discovery of flowing artesian water in Artois, France, was made many centuries before its geologic cause was discovered; but, when this was found, the discovery of similar wells was vastly increased. The discovery of oil for the first time in a boring was made in Pennsylvania in 1859, and was a wild venture, unguided by scientific conceptions; but, step by step, economic geology came to the rescue, and finally, some 30 years later, Dr. I. C. White developed his theory that oil was to be found where certain structural features of the rocks favored its accumulation. From that time the search became an intelligent exploration. Thus many geologic phenomena have been used for practical purposes by man before geology has made their causes known. On the other hand, the causes of many geologic phenomena have been discovered long before their usefulness has become apparent; but in years or perhaps generations later this knowledge has become of value to the human race. A striking instance of this is the careful petrographic study of rocks which has been developed in recent years and which at first was apparently purely unpractical. It has now, however, become of great importance in deciding the resistance of different rocks to atmospheric and other conditions. If such knowledge had been available in bygone ages, many stone structures might still be standing, because they would have been built of more durable rocks; many of our highways, quickly torn by the automobile, might have been made durable for ages.

The Uranium and Radium of Katanga

By M. H. Buttgenbach

*In 1913, in the course of development work done by the Belgian company known as the Union Minière du Haut Katanga at the Luswishi copper mine, situated a few kilometres north of Elisabethville, an important discovery was made. Several small veins, at the most 30 centimetres wide, filled with a mineral of unusual appearance, were exposed. The vein-filling consisted chiefly of uranium oxide.

Since then I have examined specimens of this ore, which occurs in the form of compact lumps; it has a density of 5.08; it scratches calcite; in color it is orange-red, and it includes grains of a black mineral several millimetres thick. On the outside these lumps have the appearance of being the result of the alteration of cubic crystals that have been agglomerated; however, they are covered with a coating the color of which shades from yellow to yellowish green; this coating extends occasionally into the minute cracks that traverse the orange-colored lumps.

By means of photographic tests I ascertained that each of the three substances—the black grains, the orange lumps, and the green coating—were radio-active, but with an intensity varying in the order indicated. The black grains produced an impression on the plate in a few hours only, whereas the green coating required an exposure of nearly two days. From this same ore I was able to obtain several decigrammes of barium chloride distinctly radio-active.

The complete analysis of an orange-red lump, as made by M. C. Gillet, on a specimen that had been carefully selected, gave the following results:

Uranium	68.203%
Lime	10.360
Lead oxide	6.388
Barium oxide	1.655
Copper oxide	0.145
Silica	2.804
Combined water	9.449
	99.004%

The oxide of uranium indicated is the dioxide, UO_2, calculated after precipitation of all the uranium as sodium uranate, but it is probable that the uranium occurs in the ore partly as UO_2, partly as UO_3.

In density, color, hardness, and composition this mineral resembles 'gummite', which may be considered as a product of decomposition from pitchblende, and to which Foullon gives the formula

$$(Pb, Ca, Ba)\ 0.3UO_3 \cdot SiO_2 \cdot 6H_2O$$

The analyses given for this mineral in textbooks moreover show that its composition is very variable.

*Translated by the Editor from 'Le Mouvement Géographique' of July 3, 1921.

The green part that covers the gummite has a composition even more complex. In general, the content in silica increases and in uranium decreases. The following result of an analysis, likewise made by Mr. Gillet, gives an idea of its composition, but I ought to add that it was not possible to collect as pure a sample as in the case of the gummite.

Silica	15.266
Uranium	45.515
Lime	6.340
Lead oxide	3.897
Copper oxide	1.386
Cobalt oxide	2.500
Nickel oxide	1.520
Oxides of iron, aluminum, and manganese	8.480
Combined water	12.103
	97.007

This green matter frequently has a lustre that is greasy or waxen, but occasionally it turns into minute acicular crystals. Under the microscope, these needles, which attain at the most a thickness of five hundredths of a millimetre, show a lovely yellow tint, without appreciable dicroism. These needles give the colors of polarization below the blue of the second order; they become less bright longitudinally, following the optical axis; a negative section is perpendicular to the face of the plane surface, which appears to be a cleavage plane. Another cleavage, less easy, appears to make an angle of 87° with the direction of length. The crystals are sometimes terminated by one face, not in agreement with the second cleavage, and make an angle of 54° with the line of length.

I consider this mineral to be composed of 'uranotil', the chemical composition of which, according to Genth, can be expressed by the formula

$$CaO \cdot 2UO_3 \cdot 2SiO_2 \cdot 2H_2O$$

The Luswishi ore then is composed chiefly of gummite, resulting from the alteration of pitchblende, of which there still remains intact in the lumps some portions in the shape of black grains. The gummite itself has yielded uranotil.

It is conceded nowadays that the ores of uranium contain radium in the proportion of 320 milligrammes of metallic uranium per ton. One ton of the Luswishi ore, at 60.2% of uranium dioxide, therefore would contain 601.17 kilogrammes of uranium and 192 milligrammes of radium. It is true it seems that the proportion indicated above of uranium to radium is not exact except for the primary minerals of uranium and that the proportion diminishes in the minerals resulting from their decomposition. However that may be, the Luswishi ore is extremely radio-active, as proved by the experiments I made with the electroscope. One knows that the radio-

active power is measured by the velocity of discharge of that instrument when under the influence of the mineral reduced to a powder and compared with that of the black oxide of uranium, UO_2. The mean of six trials showed a power of 2.969, the standard being based upon 0.202 of uranium oxide.

The investigations conducted at the Luswishi deposit were interrupted by the War. However, in 1915, a similar discovery was made in a deposit at Shikolowe (Kasolo), situated south of Kambove. Whereas at Luswishi the veins containing the uraniferous ore are very narrow, at Shikolowe the vein assumes the shape of a rosary, with swellings and pinchings. The enclosing beds, with a strike N.70°E., are composed of the rocks usual to the copper deposits of that region: talcose schists, dolomites, breccias. These beds are much disordered and cut by faults, and there are found impregnations of ores containing copper, cobalt, and manganese. Generally the beds dip northward, whereas the uraniferous veins dip to the south, at an angle ranging from 20° to 45°. In the swellings the vein is almost entirely filled with an orange-red mineral which is referred to gummite; in the pinchings the gummite gives place to a mineral in micaceous flakes which may be chalcocite or autunite. But, not having as yet received specimens of this deposit, I cannot say what is to be thought of this phosphatic ore, the like of which has not been found at Luswishi.

The known deposits of uranium and radium may be classified as follows:

1. Deposits of pitchblende (uranate of uranil) in the form of veins with a complex filling.

2. Deposits of autunite (hydrous phosphate of uranium and lime) filling crevices in pegmatite.

3. Deposits of carnotite (vanadate of uranium, potash, and lime) consisting of sandstone impregnated with this mineral.

4. Deposits of betafite (niobo-titanate of uranium) consisting of concentrations in pegmatite.

It is very probable that the uraniferous and radioferous orebodies of Katanga ought to be referred to the first type. The prospecting operations are being continued. It is unnecessary to direct attention to the importance this discovery may acquire, for the introduction into Belgium of a new chemical industry enabling, by the aid of ores coming from the colonies, the obtaining of a product the use of which is limited by its scarceness, and of which among others medicine, experimental as well as clinical, demands without ceasing larger quantities.

Russian Metallurgy Under Soviet Rule

*The largest pre-war copper production in Russia was at the Kishtim works in the Urals, where in 1914 more than 32,258 long tons (2,000,000 poods) was produced. This declined about 20% during the first years of the War, and has now practically ceased, only a few small works being in operation. Although deposits of zinc ore are found all over Russia, the production of the metal in 1914 did not exceed 1129 tons, but works with a productive capacity of 48,387 tons per annum were begun in 1915 and, although not finished, produced 29,032 tons of metallic zinc by the end of 1917. The revolution arrested the completion of the works, but it is believed that, could they be started again, not only the home market but also foreign demand might be satisfied, especially as many of the Siberian deposits contain sufficient silver and gold to reduce the cost of production below that of the United States or Germany. Lead-ore mining was begun in Russia in 1704 and during the 18th century production steadily increased; it began to decline during the 19th century owing to the difficulties encountered in working the complex ores found in Siberia. In 1916, however, works for the production of more than 16,000 tons annually were erected at the Ekibastus mines, and mining was commenced in the Kirghiz steppes, the Caucasus, and the Urals. The completion of the South Siberian railway should develop a country rich in lead ores and with good coal deposits, of which those at Ekibastus and Kuz-Chikinsk are already worked. The Russo-Asiatic Consolidated Co., on completion of its projects, should be able to produce annually metals and minerals (including coal) to the value of over £40,000,000. In 1913 Russia produced about 56% of the total world's output of manganese but only 5% of its pig-iron. The large surplus of manganese ore supplied 65% of the total German requirements; and as in future Germany will have to rely entirely on Russian supplies, the future of the industry seems assured. The fuel crisis is the real cause of the delay in reconstruction, as the following figures for fuel consumption show:

Year	Consumption of coal, long tons	Consumption of wood, 1000 cu. ft.
1916	24,552,758	5,837,517
1917	.....	4,474,778
1918	.....	3,257,471
1919	5,487,435	2,454,165
1920	5,080,354	.....

(1 ton = 62 poods; 1 cu. sagene = 343 cu. ft.)

The average monthly production of petroleum in 1920 was only 40% of that for 1913, and is still decreasing, being now inadequate to meet the home demand. The output of pig-iron has fallen from 4,651,581 long tons in 1913 to 44,113 tons during the first half of 1920; 520,000 workers are now employed. Many works have been closed, but the Government is running 21 so-called storm factories (employing 65,678 workers), whose duty is to reconstruct the disorganized transport system by intensified production and to form a nucleus for the revival of industry. These factories are given first call on supplies, but have been hampered by labor difficulties, especially absenteeism, due to difficulty in getting food. The Communists have recognized the insolvency of their original system and now seek to introduce individual management, to create a labor army, and to bind the men to the works. Unfortunately in applying these principles the works have been overstaffed with officials, of whom there are two to every three workers.

*Abstracted from the 'Russo-British Chamber of Commerce Journal'.

The Mining Industry of Mexico: A Historical Sketch

Part II

By Robert G. Cleland

(1810-1910)

EFFECTS OF THE REVOLUTION. At the close of the Colonial Period, the mining industry of Mexico was at its height. The average annual yield of gold and silver was between $20,000,000 and $24,000,000. The price of quicksilver and the duties on supplies had been reduced considerably. A Mining Bank under royal control provided funds at reasonable rates for the development and rehabilitation of desirable properties; a school of mines promised to remedy the lack of scientific knowledge and technical skill under which the industry labored. But in the midst of this prosperity came the War of Independence, with its accompaniment of brigandage and crime. At the close of the ten years of revolution the industry was almost in ruins. Its demoralized condition was thus described by H. G. Ward, British chargé d'affaires in Mexico from 1825 to 1827:

"The Civil War entirely destroyed the chain of communication between the highest and lowest classes of mining speculators. In many districts the 'haciendos' of the 'rescatadores' were ruined, as were the machinery and works of the mines themselves. In others, water was allowed to accumulate to an immense extent, in consequence of the suspension of the usual labors; while in all, the merchants who had before supplied funds for carrying on the different operations, withdrew their capital as soon as the intercourse between the seat of government and the provinces was interrupted. In the years 1811 and 1812, the agricultural produce of the country likewise decreased so rapidly that it became difficult to procure the means of subsistence. The mining towns were surrounded by insurgent parties, which occupied the whole of the open country, and rendered it impossible either to receive supplies or to make remittances, without the protection of a large escort; while the exactions of the officers, by whom these escorts were commanded (exactions which were reduced to a system, and in which the viceroy himself largely participated), doubled the price of quicksilver, and every other article consumed in the mines; and thus reduced the value of silver to the miner so much that the marc did not repay the cost of extraction, even with the richest ores. The poor ores were allowed to accumulate untouched.

"This was the real evil of the Revolution. It was not the destruction of the 'material' of the mines, however severe the loss, that could have prevented them from recovering from the shock, as soon as the first fury of the civil war had subsided; but the want of confidence, and the constant risk to which capital was exposed—which from being in so tangible a shape, was an object of attraction to all parties—led to the gradual dissolution of the system, which it had required three centuries to bring to the state of perfection in which it existed at the commencement of the War of Independence."

The physical injury to which Ward referred was more serious than one gathers from his description. Most of the mines had filled with water, the timbering in others had decayed, causing them to cave; even those that had remained in operation had suffered fully as much damage as the others from 'high-graders', or *buscones*, who robbed the pillars and veins of the more valuable ore, thus letting the roof fall in or leaving behind mineral of so low a grade that the mine could not be worked with profit. The industry had also suffered from the disruption of its labor force, for the mine employees had been forced to quit their occupation and join with one or the other faction. As a result, the annual production decreased from 20 or 24 millions to about 4 millions. The need for re-creating the industry, both to secure public revenue and to revive business generally throughout the country, was acute. But Mexico had no capital with which to do this, for the original mine-owners, mostly Spaniards, had been killed or driven from the country; the old system, under which operations were financed by the merchants and ore-buyers, or *rescatadores,* was broken up by the revolution.

ENTRANCE OF FOREIGN COMPANIES. Capital had to be secured if the mines were to be re-opened; the foreigner was invited, both by the agents of mine-owners, who went to England, France, and the United States for the purpose, and by Mexican government officials, among whom the most notable was Lucius Alaman. The general mining laws of Spain made no distinction between alien and citizen; but the law of the Indies forbade the presence of strangers in the colonies, so that the mines of Mexico had been closed to foreigners throughout the Colonial Period. In 1823, however, a decree was passed permitting foreigners to acquire shares in mining properties. This was followed by the organization of a number of foreign companies to exploit the abandoned Mexican mines. Seven of these companies were financed by English investors. One of them, the Anglo-Mexican Co., capitalized at $5,000,000, in three years spent over $4,000,000 in the operation of its 36 mines, some of which were among the most productive of the Spanish period. Another, the United Mexican Mining Association, capitalized at $6,000,000, owned mines in Guanajuato, Zacatecas, Chihuahua, Oaxaca, Hidalgo, Michoacan, Mexico, and Guerrero; it also established iron works in Durango, and operated the mint in Mexico City. The Tlalpujahua Co., with a directorate partly English and partly French, was capitalized at $2,000,000; it owned 86 mines, of which it operated 39, and employed over 2000 men. The remaining English companies, among

which was the Real del Monte, operated on a less extensive scale in various parts of the Republic. German capitalists organized the Eberfeldt Mining Co. and secured properties in Hidalgo, Mexico, and Michoacan.

Investors in the United States also became interested in the Mexican fields. Joel R. Poinsett, the first American Minister to Mexico, was alarmed at the growth of English influence in the country and sought to counteract it by the organization in the United States of mining companies similar to those of British origin. One of these American companies was incorporated in Baltimore; the other, the United States Mexico Co., secured a charter from the legislature of New York, and obtained possession under lease of mines in Tamascaltepec, among which was the Cinco Señores, about a hundred miles from Mexico City.

For a number of years, on the other hand, the British companies carried on extensive operations and aroused an excitement among the investing public comparable to that of the South Sea Bubble a century before. Fabulous reports were spread as to the riches of the Mexican mines. Baron Von Humboldt, whose 'Kingdom of New Spain' appeared in 1811, was drawn upon for statistics and alluring descriptions, thus doubtless proving the unwitting cause of many an English investor's downfall. The directors of the British companies were as little acquainted with the true situation in Mexico as were the stockholders. Without taking into account the real ability of their Spanish predecessors they tried to supplant everything native by importations from Europe. Huge steam-pumps and other machinery were shipped from England, and transported over specially constructed roads to the mines of El Oro, Guanajuato, and even as far as San Luis Potosí, at enormous labor and almost prohibitive expense. Adits and underground workings costing thousands of pounds were undertaken without careful estimates of the results to be achieved by their construction. Cornwall was deprived of half its population to furnish workmen in place of the skilled Mexican miners. Follies too numerous to mention absorbed the capital of the shareholders, together with the large quantities of bullion that some of the mines produced.

Other factors, besides unwise management, contributed to the failure of these early foreign ventures. The disturbed condition of the country and the difficulties of transportation furnished unforeseen drains upon the capital advanced; the condition of the mines themselves was such as to make large profits somewhat doubtful. Under Spanish ownership most of these had been worked to such a depth that, even with machinery, the cost of raising the ore to the surface and of keeping the workings free from water consumed a large proportion of the returns, and in numerous cases absorbed much more than the mine was capable of producing. Furthermore, the Mexicans took advantage of the ignorance of the foreigners when negotiating the *avios* or leases under which the properties were held. As a result of these unfavorable circumstances, most of the British companies suspended operations before 1835 with serious loss to the shareholders. The few that remained continued to operate with ever increasing deficits, until all but one or two were forced to withdraw to escape bankruptcy. The first experiment of foreign exploitation of Mexican mines thus ended in failure.

Obstacles and Handicaps. After the disappearance of foreign companies the mining industry settled down to a period of quiet. Production averaged about $12,000,000 per year, most of which came from a few large bonanzas. After 1850 there was some increase of this amount, but the stormy days of French intervention and the revolutionary period succeeding brought the industry to the verge of ruin. In 1877 the combined output of gold and silver amounted to only $13,000,000. The northern border States—Sonora, Chihuahua, and Coahuila—were undergoing a reign of terror at the hands of the Comanche and Apache Indians, who carried on their depredations without any opposition from the Government. Operations in nearly all the mines of Coahuila had been suspended, and the State was reduced to a wilderness. Chihuahua had been brought to the verge of ruin and was partly abandoned. In Sonora, "the land of romance, the land of tragedy, the dreamland of the filibuster", not more than 14 mines were being worked at full capacity.

In addition to Indian depredations, the country was over-run by bands of outlaws or lawless soldiery. Shipments of bullion could be made only under heavy guard; the rate of exchange with the interior was high, running as much as 10% between Mexico City and Chihuahua; travel in the interior was dangerous; mining companies were frequently robbed of supplies and bullion, or forced to contribute to the support of military bands.

In addition to these difficulties others no less serious but of a different character retarded mining development. Taxes had constituted a serious handicap to the industry, even during the Spanish period, and these had been still further increased by the Republican government; in 1825 the industry paid at least 18% to the national treasury. By 1868 these taxes had been raised to between 24 and 26%, divided as follows: assay dues, 6¼%; coinage dues, 4½%; circulation tax, 2½%; and export duties, 7½%. State taxes made up the remainder. Under such a tax, miners who found no means of smuggling their product out of the country or otherwise evading the government charges could scarcely operate at a profit.

Another drawback to the business was the lack of transportation throughout the country. Ore, bullion, and supplies had to be carried in rude carts, on mule-back, or by Indians over miserable highways or mountain trails. These methods, which are still in common practice in Mexico where railroads are lacking, were expensive and inadequate. Even with the use of carts it cost ₱20 per ton to transport supplies from Mexico City to Pachuca, a distance of 70 miles, and over ₱100 per ton from Vera Cruz. Distribution of food could not be equalized throughout the country; so that when corn

was selling for 75 centavos per fanega* in one section, a mining camp 200 miles distant might well pay ₱9 for the same amount. Large machinery could not be brought even to those mines lying close to the capital except at enormous cost; to transport such heavy material to districts lying away from well-established roads was impossible. Ores could not be shipped from the mine except at heavy cost, and consequently if too low-grade to be treated on the spot were of no value.

Another serious difficulty confronted by the industry was the lack of capital necessary to develop the mines, to install adequate machinery, and to erect modern smelting and refining works. Such sources of supply as existed under Spanish rule had come to an end with the revolution or with the disappearance of the foreign companies before the middle of the century. Mexico was consequently compelled to rely almost wholly upon her own resources, which were entirely inadequate to meet the demands of the business. Mining had therefore been reduced to a hand-to-mouth affair, conducted throughout the country, except in the case of bonanza properties, in much the same way in which General Lew Wallace found it in Chihuahua in 1867.

"Santa Eulalia", he wrote, "really ceased to be worked in any magnitude when the Spaniards were driven out of Mexico. In different ways the mines fell to owners who had little capital and still less energy. As miners, the Mexicans are, in some respects, without superiors; they can tell at a glance the quality of ore, and in the mere manipulation they excel; but when extensive management is required of them they utterly fail. When his mine is bonanza the Mexican owner loses his head; he takes no care of his money, is open-handed as a child, and acts as if the treasure was inexhaustible. Consequently, when the present 'pocket' runs out he has nothing wherewith to renew operations. As a rule, Mexicans, however intelligent and educated, have no genius for machinery. They blow, crush, and drill as their fathers before them did. For transportation of ore they prefer a train of donkeys to a train of cars, and steam-engines are incomprehensible to them. Moreover, unlike Yankees, Mexicans are not associative for purposes of business; in fact, they know absolutely nothing of association as an element in great enterprise. As for the individuals, there is but one gentleman in Chihuahua rich enough to work Santa Eulalia as it deserves, and he is a merchant, and, strange to say, bitterly opposed to mining, although his fortune came from that source. If it depended upon the present owners, work in the mines would altogether cease. They derive aid, however, from others. Thus Señor Mateas has his backers in the City, who advance him limited sums of money, which he uses to pay his workmen and meet current expenses; when he brings the product of his labor to market and sells it, he not only returns the principal of the loan, but also pays his accommodating friend two-thirds of the profit. Such a system, together with the modes pursued, will keep that excellent gentleman poor though he owned all the mines in Mexico and lived a thousand years. As for foreigners, Frenchmen, Englishmen, and Americans have often sought to obtain the control of the mines of Santa Eulalia, but in vain."

In addition to this lack of capital the confusion in laws resulting from the constitutional grant of 1857, under which each State could legislate on mining matters, also hampered the development of mineral resources. Under the Mexican system of mining and metallurgy, moreover, the mines were becoming increasingly difficult to work. In the older regions some shafts, like that of the Valenciana, were down nearly 2000 ft. To bring the ore to the surface from such depths and keep the lower workings clear of water were problems too great for the Mexicans to solve; districts once famous for their riches, like that of Guanajuato, were gradually abandoned. High-grade ore, relatively easy to obtain, alone was profitable; of the baser metals, such as iron, lead, and zinc, there was no production in commercial quantities. Copper was mined almost entirely for use in the amalgamation of silver. Coal was not produced.

Revival Under Diaz. Such in general was the situation when Diaz became president. During the first years of his administration the northern States were freed from the menace of the Apaches and Comanches as a result of the combined activities of Mexican and United States troops. Domestic peace was also established, by what means it is not the function of this article to say. Life and property, however, became so safe throughout the Republic, with the exception of the Yaqui region in Sonora, that it might be said of Diaz as it was said of one of the early kings of England, "a man with his wallet full of gold might walk scathless from sea to sea". Prospectors and mining engineers found it possible to penetrate remote mountain regions without danger to life or fear of robbery. Mining camps were established in isolated regions, and suffered no harm from outlawry or depredations. Companies were also able to transport their bullion under a small guard, usually of native Mexicans, without danger of loss. The Batopilas company, for instance, though its mine is in the heart of the Sierra Madre mountains in south-western Chihuahua, sent out over thirty million ounces of silver from 1887 to 1910 without the loss of a single bar. The shipments were made by pack-train under native guard over a mountain trail. Ten days or more was required for each trip.

In addition to establishing security for life and property, President Diaz encouraged the building of railroads and the development of transportation facilities. Nothing had a more stimulating influence upon mining development in Mexico than this. Regions hitherto inaccessible were opened up. Heavy machinery, both for the mines themselves and later for the development of hydro-electric power, together with material for the erection of modern metallurgical plants, could now be brought in without prohibitive cost. Low-grade ores could also be shipped to the smelters; the price of mining supplies, such as candles, salt, explosives, and lumber, was reduced considerably; laborers found it possible to buy food at lower prices; and the use of coal for the generation of steam, which before had been restricted because of the scarcity and prohibitive cost of fuel, now became much more widespread.

Even before the accession of President Diaz, mining taxes had been reduced greatly. But to encourage the industry still further, and especially to attract the out-

*About 100 pounds.

side capital without which the mines could not possibly be developed, the Mexican Congress in 1884 and again in 1887 amended the Mining Code for the benefit of the foreign investor. The condition of the industry—and, indeed, of the whole country was then such as to demand governmental stimulus. The low price of silver, which characterized the period beginning about 1880, threatened not only the mine proprietors but the revenue of the Government and the economic life of the nation.

Under the Code of 1884, drawn up by a committee of mining engineers and lawyers under the direction of the Department of Fomento and participated in by various States, the mining laws of Mexico were unified, and the powers of legislation on mining affairs was taken from the States. Materials necessary for mining operations were relieved of taxes and import duties, and a maximum limit of 2% was fixed for State taxation. Coal, iron, and quicksilver mines were exempt from all State taxation for fifty years; beneficiating plants could not be taxed at higher rates than those fixed for any other industrial enterprise.

The Code of 1887 granted to the Federal Executive the power to enter into special contracts with companies which should invest not less than ₱200,000 within five years in mining enterprises or metallurgical works. These companies were granted special franchises, or concessions, relieving them of local, State, and Federal taxes for a period of ten years. Such legislative aids were not innovations either in Spanish or Mexican law; they represented the wishes of mining, financial, and business interests generally throughout the Republic. From the legislation of 1884 and 1887 the development of Mexico's mineral wealth received a surprising impetus. Production of gold and silver, which in 1877 amounted to slightly over 26 million pesos, had risen by 1890 to 43 million. Lead and copper were also being produced in considerable quantities; coal had been discovered in the Sabinas basin of Coahuila and was being mined to good advantage.

Re-appearance of Foreign Companies. The greater part of this revival was due to the influx of foreigners and of foreign capital. Even before 1884 many Americans had entered the country from the South-Western States; as the excitement of 1849 began to die out in California, scores of prospectors crossed into Sonora or went by boat to Lower California; others took up properties in Chihuahua and Sinaloa. By 1865 over thirty American companies were operating in the northern Mexican States or in the vicinity of Triunfo and San Antonio in Lower California. The investment of these companies amounted to about $12,000,000. San Francisco and New York were the parent cities of most of these concerns, some of which acquired possession of famous properties, and numbered widely known Americans among their directors. The mines of San Dimas and Guarisamey, which made their owner, Zambrano, one of the great men of New Spain in the 18th century, passed into the possession of New York capitalists. General Lew Wallace and Colonel George E. Church became the owners of celebrated properties in the Santa Eulalia district in southern Chihuahua. The Batopilas mine, famous for two centuries for the virgin silver it produced but almost abandoned after the Mexican revolution, was purchased in 1861 by James R. Robinson, of New York, who organized the Batopilas Silver Manufacturing Co. and worked the property for 19 years, taking out nearly $3,000,000 in silver. The discovery of placer deposits in 1878 in the Sierra Mojada region of Coahuila led to a mining rush of large proportions to the new fields. Fully 5000 prospectors from the south-western part of the United States, according to E. L. Doheny of the Mexican Petroleum Co., who was one of their number, took part in this stampede; but as a placer field the Sierra Mojada region proved a failure. In later years, however, its lead-silver deposits made the region famous.

With the exception of a few companies already mentioned, most of the Americans engaged in mining in Mexico before 1880 were prospectors without much capital. They were hardy, virile, and picturesque; but most of them had the typical Westerner's contempt for anything Mexican, and paid little attention to local laws. This was especially true when a party of four or five well-armed men reached some out-of-the-way Mexican village after weeks of prospecting in the mountains. They drank freely, perhaps on occasion 'shot up' the town, and were almost certain to play fast and loose with the girls and young women. Much of the ill-feeling still cherished by the Mexicans in the border States against Americans may be traced to the actions of these early prospectors.

Boleo and Batopilas Companies. In the early 'eighties the small foreign companies in Mexico began to be reinforced by well-organized concerns, with sufficient capital to revolutionize the mining industry. About 1880 General Frisbie and J. B. Haggin organized the American Mining Co. and took over the El Oro mines, which they controlled until their sale in 1900 to the El Oro Mining & Railway Co. In 1885, French investors, supported largely by the Rothschilds, organized the Compagnie du Boleo with a capital of twelve million francs, to exploit the copper deposits of Santa Rosalia in Lower California. In 1886 a concession was granted by the Mexican government to Alexander Robey Shepherd for the exploitation of numerous silver mines in the district of Batopilas. Shepherd, who had been governor of the District of Columbia under President Grant, came to Mexico in 1879 and bought the San Miguel mine at Batopilas from the Robinson interests, paying $600,000 for the property. Between 1880 and 1886, Shepherd purchased various other holdings and finally organized them into the Batopilas Mining Co., with a capital of $9,000,000. Within a short time many other foreign companies were seeking special contracts with the Mexican government under the terms of the law of 1887.

Establishment of Modern Smelters. Under this law, also, modern smelting plants were established for the first time in Mexico. Previous to 1890, ores that required smelting were shipped to the plants across the

border. This involved such heavy freight charges that few ores could be treated profitably. The inducements offered by the Mexican government to smelting companies were further supplemented by grants, mostly in the form of tax exemptions, from several State legislatures. The low cost of Mexican labor proved an additional attraction. A further reason for carrying the business across the border was the passage of the Windom Law by the United States government, which, in an effort to protect the lead producers of the United States from competition with the product of the Sierra Mojada mines, laid such heavy duties on the importation of lead ores that these could no longer be shipped across the line with any profit, and had to be smelted in Mexico.

The Guggenheims were among the first foreigners to engage in the smelting business in Mexico. A concession was secured under the law of 1887 allowing free importation of machinery, construction material, and coke from the United States. Plants were erected between 1890 and 1895 at Monterrey and Aguascalientes, and somewhat later at Velardeña, Chihuahua, and Matehuala. All of these are now controlled by the American Smelting & Refining Co. or its subsidiaries. In addition, the same corporation acquired about ten mining properties and an important railroad system.

A number of other smelters were built during the early 'nineties by competitors of the Guggenheims. The Cia. Metalurgica Mexicana erected a large plant at San Luis Potosí in 1892, receiving ores from the mines of at least eight different States. The Peñoles company, at that time a German-Mexican concern, had a smaller plant at Mapimi, in Durango. Later, the Cia. Metalurgica de Torreon, a Mexican concern, built the third largest silver-lead smelter in the Republic at Torreon. All told, besides the smelters maintained by the important copper companies to handle their own ore and care for custom business, seven large silver-lead smelters, with a combined capacity of over 2,000,000 tons per year, were erected in the mining centres of the country.

Increase of Foreign Investments. In spite of the large investment of foreign capital after 1885 and the organization of the smelting business, the mining industry of Mexico faced a serious difficulty in the early 'nineties, due chiefly to the continued fall in the value of silver. The Government, feeling that this might be offset in some degree by more favorable legislation, passed a law in 1892 making radical changes in the requirements under which mining claims might be held. According to the colonial law, mines left unworked for four months or more reverted to the Crown, and became subject to denouncement. The law of 1884 provided that at least six workmen must be employed on a claim for not less than 26 weeks out of the year, or ownership was forfeit.

By the law of 1892, however, payment of taxes was made the sole requirement for retention of ownership. These taxes were based upon the number of pertenencias in a claim, the pertenencia as under previous laws constituting the indivisible unit of mining concessions. Its dimensions were now 100 metres on a side, equal to one hectare, or 2.47 acres. The rates imposed by the new Code called for the payment of an annual tax of $10, Mexican gold, in three installments for each pertenencia in a claim, and a stamp tax of the same amount payable upon the issuance of the patent. In 1905 these rates underwent the following modifications: the stamp tax was reduced to ₱5 per pertenencia, and the annual tax became ₱6 for each pertenencia up to 25 in a property, and ₱3 for each pertenencia in excess of that number.

In addition to the revenue this law was designed to bring, its object was to encourage the industry by making conditions favorable for large investments of capital, especially in low-grade properties. Under its provisions, companies were able to denounce large areas; and, by paying slightly over $1 per acre in stamps and an annual maximum tax of about the same amount, they could hold their properties in perpetuity. The intrusion of rivals could thus be prevented, and a sufficient supply of ore provided to justify extensive development work and the expenditure of large sums for machinery and reduction works. Beneficial though this law undoubtedly was, there were in it two elements of danger: It permitted mining properties to be held for purely speculative ends, and enabled large companies to obtain possession of unreasonably extensive areas for strategic purposes, retaining them undeveloped, to the serious injury of smaller rivals and to the nation as a whole.

The law of 1892 was followed two years later by legislation designed to increase the production of gold. Some such stimulus was badly needed. The price of silver was still low, and Mexico's output of gold, less than $1,250,000 annually, was wholly insufficient to offset the decline in silver production. The new law permitted the Executive to enter into special contracts for one year with companies or individuals seeking to discover or exploit gold placers. It is significant that the annual production of the metal increased, within one year after the passage of the law, from 59,000 oz. to 235,000 oz., and had risen by 1900 to 444,000 ounces.

Under the stimulus of favorable legislation and the growing sense of confidence in the stability of political conditions, large numbers of foreign companies, most of which were American, entered Mexico. As the foreigner became interested in the industry the Mexican gradually withdrew; little by little the important properties passed out of his control, until by 1912 of a total investment in the mining business estimated at $323,600,000 he could lay claim to less than $15,000,000. The following table shows the mining investments by nationalities:

	American	British	French	Mexican*	Miscel.
Mines	$223,000,000	$43,000,000	$5,000,000	$7,500,000	$7,830,000
Smelters	26,500,000	.....	.....	7,200,000	3,000,000

*The acquisition of the chief Madero properties by the American Metal Co. greatly reduced the above valuation of Mexican holdings.

As the prosperity of the industry in 1810 was cut short by the Hidalgo revolt, so that which distinguished the first decade of the 19th century suffered an analagous eclipse in the chaos that followed Madero's brief acquisition to power.

(To be Continued)

A BIT OF OLD MEXICO

THE CITY OF GUANAJUATO

ZACATECAS, MEXICO

CARRYING ORE FROM THE CARMEN MINE

A HALT ON THE WAY TO THE MINES

A TROMMEL UNIT IN THE BELGIAN CONGO. JOPLIN JIGS UNDER THATCHED ROOF IN FOREGROUND

DIAMOND MINE, SHOWING NATIVES CARRYING GRAVEL IN BASKETS. THE BEDROCK OF SANDSTONE IS SEEN IN THE FOREGROUND

Experiences of a Mining Engineer in the Kasin Diamond Fields, Belgian Congo

By J. E. Robison

The Forminière*, a corporation operating in the Belgian Congo, employs a number of American engineers in its exploration and mining activities. The work, up to date, has been confined chiefly to the exploitation of diamonds. The technical part of the undertaking offers little of interest from an engineering standpoint; the great bulk of the work is carried on by hand, necessitating in most cases simple and primitive methods and machines. The great distance from the base of supplies, and the difficulties of transportation, largely account for this.

When a mining engineer who has accepted a position with the Forminièrè arrives in the Congo he is confronted, not only with a new language and new customs, but with an unfamiliar country; with all of these he becomes more or less acquainted on his trip into the interior. He arrives at Matadi, the port of entry, situated about 50 or 60 miles up the estuary of the Congo river. He then proceeds alternately by rail and water, arriving three weeks later at D'Joko Punda, the head of navigation on the Kasai river and the outlying post of the Forminièrè. D'Joko Punda is the inland receiving station for supplies. Here the river-boats discharge their cargoes, which are then forwarded to Tshikapa. Tshikapa is headquarters of the Société in Africa. Material is shipped beyond D'Joko Punda by truck, tractor, caterpillar, Ford automobile, or on the backs of native *porteurs*—in fact, by any means so long as it reaches its destination. The engineer continues his journey, by Ford if he is lucky, if not, in a hammock *tepoy*, arriving at Tshikapa about four days later. The managing engineer then assigns to him his future work. He is usually detailed to a development or prospect camp, where he is 'broken in' by an experienced man. The development camps are, as a rule, from two to three days travel from Tshikapa, so that the newcomer is virtually in the midst of the jungle at last.

Development is carried on by sinking rows of pits or trenches across the valleys. Usually these are placed at intervals of 100 metres. The work is mapped, and cross-sections are made of the pits, showing the depth of overlying gravel and the contour of the bedrock. The gravel is washed and classified in screens of the hand-rocker type nesting in each other. The resulting classified products are treated on Joplin jigs, and the concentrate is hand-sorted for the diamonds. Reports are then made on each pit, showing the volume of gravel washed, the diamonds recovered, and the percentage of each size of classified gravel based on the 'meterage' washed.

*Société Internationale et Forestiere et Minière du Congo.

The new man is left with the experienced engineer for about two weeks, during which time he becomes familiar with the methods in vogue and also acquires a smattering of the native dialect. The older engineer is then transferred to another post, and the newcomer assumes charge. Then commences his fun and his real initiation. He has by this time a cook, a personal boy, and sundry other servants; he soon learns that his vocabulary is so limited that if he orders eggs for his morning meal, he may be served sweet potatoes, or anything other than what he wants; in his own obtuseness he blames the native, who suffers accordingly. He experiences the same difficulty in carrying out his work, but fortunately he has fallen heir to a trained crew. During this period he is being tested by the natives, who become lax in their work and in various ways tax his patience until he demonstrates the stuff of which he is made; then things hum along in their accustomed way. He is christened with a new name, according to native fashion, that is indicative usually of some physical characteristic or a peculiar trait: the native equivalent of 'Slim', or 'Shorty', or 'Fatty'. If the engineer is of the choleric type he will receive such names as 'The Leopard' or 'The one who beats them'. The name 'The Leopard', for instance, signifies that the workers should be wary of him; for, like the animal in question, he may spring at them. The name that an engineer receives is important, for, if it signifies a hard man to deal with, he will as a consequence find it difficult to secure native laborers or to hold them in his employ. This is the one big problem that either helps or retards his work. Food and game usually abound, and there is no reason why a native should work except to accumulate enough money to purchase a wife. All wives are acquired by purchase in the Congo; they pay the price before marriage; we, as a rule, pay it afterward.

Taking into consideration the fact that economic pressure does not force a native to work, it devolves on the engineer to make working conditions as attractive as possible in order that the natives shall be fairly contented and happy while under his supervision. To do this he must see that they are well housed and that their living conditions are attractive from their standpoint. He must maintain, if possible, an adequate and diverse supply of food. He becomes a 'chief' to the natives in his immediate neighborhood, who look on him as their protector as do his workmen. He is called upon to adjudicate all sorts of grievances, ranging from petty theft to various martial infidelities leading to divorce, all of which must be settled according to a curious mixture of native custom and his own ideas of justice. The natives accept the

decisions generally without question, and gradually the white man acquires an influence and authority that materially assist him in carrying on his work.

The engineer's custom of administering treatment in case of injury or sickness tends to foster among the natives a sense of protection, and show them the advantages of being in the white man's employ. The ills will range from wounds and pernicious ulcers to fevers and various chronic ailments. So, with inspiration as his Esculapius, the engineer delves into his medicine-chest and proceeds to prescribe, his usual panacea being a strong purgative. It is not quite as haphazard as it sounds, for he is furnished by the resident physician at Tshikapa with various medicines for prevalent diseases. All of this goes to make up the daily routine of the engineer while 'off shift'; it serves to make an interesting life of what otherwise would be a drab existence. However, he is thankful when the end of his two-year contract comes, and when civilization and the good old U. S. A. loom on the horizon.

The engineer, after remaining on development work for five or six months, is usually relieved by an incoming engineer and is then given charge of a party on exploitation. Whereas, formerly, he had perhaps 100 laborers, he will now have 600 or 700 with their attendant families, and his duties in looking after them will be increased proportionately. Exploitation camps in general are equipped with hand-operated six-foot Kimberly washing-pans. These pans treat all the undersize gravel from a two-mesh trommel, the oversize from which is stacked for future treatment. The pans are cleaned about every hour; this of course varies according to the diamond content of the gravel washed. The resulting concentrate is re-concentrated in various types of hand-jigs and is then run over greased tables. The Société is at present installing mechanically operated units, but will adhere to the same flow-sheet.

Formerly the gravel was classified in four trommels in series; 2-, 4-, 8-, and 16-mesh screens were used. The three intermediate sizings were concentrated in Joplin jigs, and the concentrates resulting were hand-sorted. However, this method has given way almost entirely to the pan-plant method. The methods employed in working the shallow alluvial deposits are identical with those of the old Californian 'forty-niner' in 'shoveling up'. Bedrock is cleaned in the same way also. The gravel is transported to the washing-plant in small wicker baskets, which the natives carry on their head. The basket-loads average about 125 to the cubic metre. The small river valleys are generally heavily forested; clearing is carried on by ordinary methods; the larger trees are suitable for lumber, which is prepared by the whip-saw gang.

The engineer's work in an exploitation camp entails a variety of tasks other than mining. He must maintain roads in the vicinity in good condition and must build new ones if necessary. About 10% of the employees are engaged in plantation work. *Manioc* is grown extensively, as this is the principal article of food for the natives. Much attention is devoted also to the cultivation of bananas, paw-paws, and various other tropical fruits. He will have from 75 to 150 acres of land under cultivation, the area being increased gradually. The idea is to make each camp as nearly as possible a self-supporting unit. In conjunction with the main farm he will also have his own vegetable and fruit gardens. He keeps time for the men and pays them, besides operating a store to supply their needs of cloth, beds, and other items. He is called upon to train carpenters, blacksmiths, brick-masons, and, in fact, all the special men necessary for the operation of the plant. Keen is the engineer's disappointment when his carpenter or cook, on whom he has spent hours in developing some degree of proficiency, leaves the job. It means that, if a trained man be not available, the training process will have to be repeated.

Patience is indeed a virtue in this work; a choleric engineer only makes things worse; he drives men away from him. The wages for the different kinds of labor are regulated so that there is nothing for a native to gain by working for a neighbor unless it be better conditions and a more kindly treatment. On the other hand, it is obvious that strict discipline, which is absolutely necessary, cannot be coupled with leniency. The engineer must cultivate a mixture of sternness and kindness, coupled with an absolute aloofness from his men in order to hold their respect. Without respect he can accomplish nothing.

METALLIC magnesium may be derived from several nonmetallic minerals. It is produced in this country by the electrolysis of fused magnesium chloride at one plant, and of fused magnesium oxide at the other plant, states a U. S. Geological Survey bulletin. The Dow Chemical Co. uses hydrous magnesium chloride for the manufacture of metallic magnesium. The chloride, mixed with common salt in the proportion of 4:1 and with a small quantity of ammonium chloride, is heated in shallow vats over a slow coal fire to remove its combined water. About 50% of the water is driven off in this way. The partly dehydrated mixture is removed from the vats, cooled, and then completely dehydrated in a second furnace with higher temperature. The metal is then produced by electrolysis of fused magnesium chloride in a bath of salt and ammonium chloride. The electrodes used are graphitized carbon, and electrolysis takes place in cylindrical sheet-iron cells, which serve as cathodes. The American Magnesium Corporation uses magnesite mined on the Pacific Coast and calcined before shipment to the plant at Niagara Falls. During calcination the weight is reduced by one-half, owing to the removal of a large amount of carbon dioxide. The firm produces magnesium by electrolysis of the fused oxide. The electrolyte or bath is a mixture of fused fluorides, the oxide going into solution and being decomposed by the electric current. The slag is removed, and the metal is drawn from the furnaces at hourly periods and poured in small ingot molds. The metal is afterward refined. This is effected by re-smelting the ingots in small retorts.

SENATOR W. A. CLARK OPTIONS PROPERTY AT OPHIR, UTAH

The Ophir Hill Consolidated Mining Co., owned by ex-Senator W. A. Clark, has taken a lease and bond, with option to purchase for $115,000, on the property of the Ophir Coalition Mines Co. The Ophir Coalition property consists of 12 patented and several unpatented claims, and joins the Ophir Hill property on the west and south-west. Most of the Ophir Coalition stock is held by Chicago interests. There has been developed in the property a large tonnage of mill-ore, which can be treated in the Ophir Hill mill. The Ophir Hill people have recently constructed a flume from the mill, past the town of Ophir, to a point a considerable distance down the canyon. It is believed that the company is planning on treating the mill-dump by the flotation process, and will use the new flume for conveying the re-treatment tailing to a new dump. Experiments have been in progress for many months at the Ophir Hill mill investigating the applicability of the flotation process.

HOLLINGER CONSOLIDATED WILL SUBSTITUTE BALL-MILLS FOR STAMPS

It is understood that the Hollinger Consolidated is planning to increase its capacity to a maximum of 6000 tons daily by a change in grinding equipment. This will involve the discarding of the 200 stamps now in use and substituting 10 ball-mills, each having a capacity of 600 tons daily, operating in connection with the 20 tube-mills which form part of the present equipment. If this project is carried into effect it is believed that the grade of the ore may be reduced to about $8 per ton, so as to include a large amount of low-grade lying on the Millerton side of the property. At present the mill is treating from 3500 to 4000 tons of ore daily.

TENNESSEE COPPER & CHEMICAL CO. IS EARNING A PROFIT ON CURRENT OPERATIONS

The Tennessee Copper & Chemical Co. has started on an era of expansion which has removed it from the class of mining enterprises to that of an industrial producer. Today the company ranks as the largest producer of sulphuric acid in the country, although the cotton market and the small demand for fertilizers has caused the company to curtail output.

The company estimates its 1921 output of copper and acid, in comparison with two preceding years, as follows:

	Copper, lb.	Acid, tons
1921 (estimated)	8,127,296	236,707
1920	10,358,237	333,629
1919	10,414,815	266,627

Consolidating the operations of the various departments the Tennessee company in the first eight months of this year made net profit of $339,140, before depreciation but after fixed charges and after absorbing a book-loss of Southern Fertilizer Co. This loss was brought about by inventory write-offs. The parent company and its subsidiaries have quick assets of close to $3,000,000, of which $400,000 is cash and $715,000 notes and accounts receivable.

The chemical plant built and turned over to the Southern Fertilizer Co., a subsidiary, has a rated capacity of 100,000 tons of acid phosphate per year.

Under an agreement with the Internal Revenue department the Tennessee management charges between three and four cents per pound of electrolytic refined copper for depletion. Wages now paid employees are below the peak-level, yet are higher than the pre-war level. Greater efficiency has been attained, making it possible to lower production costs of both copper and sulphuric acid in the face of curtailing output.

SAN FRANCISCO MINT IS BREAKING RECORDS

The United States Mint at San Francisco is now operating 24 hours per day, coining 260,000 silver dollars daily. So efficient is the work at the plant that the Director of the Mint at Washington has sent Samuel J. Ward, who for many years has been foreman of coiners at the San Francisco mint, to Philadelphia, with the hope that the work at that plant can be speeded up. It is expected that the interest-bearing debt of the Government will be decreased by $65,000,000 within the next 90 days as a result of the production of silver dollars under the terms of the Pittman Act.

CHIEF CONSOLIDATED CO. COMMENCES SHIPPING HIGH-GRADE LIMESTONE

The lime quarry of the Chief Consolidated Mining Co. at Eureka, Utah, is ready to commence production. The company has closed a contract with one of the large smelting companies, calling for a clean screened lime ranging from 1 to 2½ in. diameter. Contracts with sugar companies call for a product varying from 2½ to 6 in. diameter. The deposit is one of exceptional purity, averaging between 98 and 99% calcium carbonate. It is estimated ther· are between four and five million tons in the deposit. Initial production will be at the rate of 150 tons per day. Contractors are constructing bins and trestles, and crushers, screens, and conveyor-belts are on the ground, awaiting installation.

SENATOR ODDIE WRITES IN FAVOR OF THE McFADDEN BILL

In a letter to A. W. Mellon, Secretary of the Treasury, T. L. Oddie, Senator from Nevada, criticizes the Secretary for following the gold policy initiated by the last Administration, which he says has affected our domestic industrial condition, export trade, and maintenance of the gold standard. He says the prophecy of the Treasury Gold Committee more than two years ago that commodity prices would decline has failed to materialize, as prices have gone so high as to shut-down gold mines. The Senator says the Treasury argument that gold mining must wait for lower prices for relief is not tenable, as the general price-level is rising instead of declining. He insists that the normal condition of the industry cannot be restored unless the purchasing power of the dollar in 1913 is restored. Senator Oddie warns that unless relief is afforded the mining industry ore-reserves will be lost through caving of mines.

He concludes by saying: "The production of gold throughout the world is declining, and unrestricted industrial consumption for years to come would be so large as to reduce the amount available for monetary purposes. This condition must be remedied if the gold standard is to survive this period of readjustment. The industrial gold consumption of the world should, therefore, be forcibly curtailed and gold production stimulated. Both of these conditions should be satisfied by an equitable adjustment in the cost and price equation between the producer of new gold and the industrial consumer. The McFadden Bill provides for such an adjustment. This constructive gold policy put into effect at this time will safeguard the maintenance of the gold standard. Such a policy is also prerequisite to a more rapid revival of our domestic industry and export trade upon which the full time employment of our people and the prosperity of the nation depends."

FLOOD AT BRITANNIA MINE, HOWE SOUND, B. C., DESTROYS LIVES AND PROPERTY

A destructive flood, following continuous rain for a month, swept the property of the Howe Sound Mining Co., on Britannia beach, on the evening of October 29. Communication with the mine has been cut and details are lacking, but it is known that a number of persons lost their lives and that half of the buildings in the settlement were washed away. C. P. Browning, superintendent at the mine, turned the assay-office into a morgue. The dispatches make no mention of damage to the mine plant. About a year ago the company's concentrator was destroyed by fire.

PRODUCTION STATISTICS IN THE JOPLIN DISTRICT

During the week ended October 22, zinc held at $25, but operators were generally optimistic and predicted that the future still appeared bright. Lead continued at $60. The total purchase for the week was 6320 tons. Following were the shipments, in pounds and value:

Oklahoma

	Blende	Lead
Admiralty Zinc Co	1,794,950	.....
Bilharz M. Co	1,118,490	86,970
Black Eagle M. Co	189,530	.....
Blue Ribbon M. Co	89,320	.....
Colgate M. Co	88,950	.....
Dorothy Bill M. Co	347,030	.....
Desperation M. Co	32,920	.....
C. & S. M. Co	218,160	.....
Domado M. Co	440,200	.....
E. & S. M. Co	458,750	.....
Golden Rod M. & S. Co	342,200	.....
Hartford M. Co	1,066,730	.....
Harrisburg M. Co	180,190	.....
Huttig L. & Z. Co	1,345,700	.....
Laclede M. Co	433,090	.....
New Chicago M. Co	79,910	.....
Oko M. Co	877,860	65,780
Premier M. Co	336,800	.....
Red Bird M. Co	515,000	.....
Rialto M. Co	178,160	.....
Seals M. Co	78,260	.....
Skelton M. Co	388,150	127,930
St. Joe M. Co	281,860	.....
Vantage M. Co	690,780	.....
Victory M. Co	912,450	92,590
Vinegar Hill Wilson	400,820	.....
Sundries	.....	1,450,220
Total	11,454,180	1,757,710

Value: blende, $143,000; lead, $53,080; total, $196,080.

Kansas

	Blende	Lead
Big Elk M. Co	.....	84,420
Blue Mound M. Co	86,480	.....
Chanute Spelter Co	583,320	.....
Empire Development Co	259,480	.....
King Brand M. Co	133,780	83,460
Lawyers M. Co	362,620	249,970
Muncie M. Co	91,960	.....
Sundries	.....	458,890
Total	1,517,540	793,280

Value: blende, $18,750; lead, $23,760; total, $52,510.

Missouri

	Blende	Lead
Acme-Neff M. Co	870,850	.....
Barnsdall M. Co	1,599,460	.....
Sundries	.....	65,000
Total	2,470,310	65,000

Value: blende, $30,750; lead, $1921; total, $32,671.

District

The week: blende, 15,422,030 lb.; value, $192,500; total lead, 2,315,990; value, $78,761; total value for week, $271,261.

Average value per ton: blende, $25; lead, $60.

46 weeks: blonde, 458,162,650 lb.; $5,192,380; calamine, 60,430 lb.; $360; lead, 102,853,720 lb., value, $3,368,767; total value, $7,847,852.

UNION OIL CO. OF CALIFORNIA PURCHASES PROPERTY NEAR VANCOUVER, B. C.

The Union Oil Co., of California, has obtained an option on the British Columbia Refineries' property, near Barnet, and has purchased the old Kirkpatrick shingle-mill. Officials of the company have been in the city for a week, and have inspected all available property on Burrard inlet. It is understood that the Union company proposes to establish a refinery business in competition with the Imperial Oil Co., which up to now has had a monopoly of the business. For long the Union company has supplied the C. P. R. Owing to the continued high price of coal, the C. P. R. is gradually converting a number of its coast steamers from coal- to oil-burners, and the new trans-Pacific liners, which will go into commission early next year, are oil-burners, while it is stated that those now in service are to be converted as soon as the new boats arrive on the Coast. Consequently the C. P. R. will use much more oil in the future than it has done in the past. The Kirkpatrick mill is to be used as a distributing station.

ALASKA

Seward.—The House Committee on Territories at Washington has reported a bill appropriating $4,000,000 to complete the construction of the Government railroad between Seward and Fairbanks. There remain to be constructed 61 miles of track, and two steel and concrete bridges. The railroad taps two coalfields and six mining districts.

ARIZONA

Oatman.—The Big Four and Henry Ford groups, of the San Francisco district, have been merged into a company, to be known as the Katherine Big Four Corporation, which will be incorporated under the laws of the State of Delaware, for $1,000,000, one-half of which will be placed in the treasury for development purposes. The promoters of the corporation have subscribed in the neighborhood of $40,000, as provided in their agreement of purchase, for the immediate installation of machinery and sinking deep main shafts on each property as rapidly as possible. The Big Four

group consisting of 90 acres, lies contiguous to the town of Katherine on the east, and about one-quarter mile from the Gold Chain group on the north; in fact a huge cross-vein from that group intersects the main vein of the Big Four group. The main vein, where cross-cut by trenching, shows value of $2 to $4 gold for a width of 40 ft. The Henry Ford group consists of 70 acres lying in the vicinity of the Old Hardy group, in the Oatman district, which latter group in the early days shipped in the neighborhood of $200,000 in high-grade ore from superficial workings to San Francisco smelters, by way of pack-train to Colorado river, and thence by boat through the Gulf of California. The main vein of the Henry Ford group shows the characteristic 'waxy' ores of the richer veins that have been developed in the Oatman section. A parallel vein to the main vein occurs also upon the property, 187 ft. away, that shows a zone of highly mineralized vein matter.

CALIFORNIA

French Gulch.—Thomas Salisbury, who has an option on the Washington mine, has commenced exploratory work. ——The company that is working the Gladstone mine has cleaned out 8000 ft. of drifts and cross-cuts preparatory to resuming production.

Grass Valley.—The Randolph Consolidated Mines Co., with a capitalization of $500,000, has been organized to develop mining properties in the Randolph section. H. L. Ostrander is at the head of the company. The ground was worked by placer methods years ago. The intention now is to develop the lodes.

Hayden Hill.—High-grade gold ore has been found in an 18-in. vein on the La Ora claim, according to William Snyder. This indicates that the high-grade ore in the district is not entirely confined to the Juniper mine, and that the ore-zone is wider than originally supposed.

Lewiston.—The Gardella dredge on the Paulsen ranch is ready for launching. The flume that will carry the water to the pit is nearly complete. The boat is 88 ft. long and has a 40-ft. beam.——C. P. Richards and P. C. Linderman have driven an 800-ft. adit in the Blue Jay property, on which they have an option.

Mariposa.—T. E. Kelso and William Holmes have purchased the mineral-bearing section of the famous Mariposa Grant, consisting of 5000 acres. The remaining 39,369 acres have been sold to other purchasers. Messrs. Kelso and Holmes plan to sink a new shaft at the old Princeton mine, where there is a 15-stamp mill and a mine-plant worth $150,000.

Silver City.—The Comstock Eldorado Co. has acquired the Dixon & Rain on the Lager Beer property, where excellent ore is exposed. The Flora Temple mine has also been leased and both will be worked under the supervision of Carl Stoddard.

Ukiah.—The old Sulphur Bank mine, situated at the lower end of Clear lake, once regarded as the richest quicksilver mine in the world, with a payroll of 700 miners, has been bought by Mocine & Martin for the New Idria Mining Co. It is understood the mine will again be operated. In old days great difficulty was experienced in working the mine because of gas, acids, and boiling water, which made it impossible for the miners to work longer than 15-min. shifts. The mine was closed down 20 years ago, but during the War the dumps were worked over and a considerable amount of quicksilver obtained.

Howe Sound. The Britannia Mine, on the Sound, Was Visited by a Flood on October 29

COLORADO

Alma.—The London mine is shipping steadily while developing through a cross-cut tunnel projected to open ground 600 ft. below the present deepest workings.——The Dolly Varden is shipping steadily, the general average is $100 per ton, while sacked ore as high as $500 per ton is shipped in carload lots.

Boulder.—The old Caribou Hill district is being revived and the adjacent ground is being re-staked. Chief among the many rich mines on the main hill is the Grant County shaft, which is being operated by the Caribou Hill Mining Co. It has opened richer and larger bodies of ore in virgin ground than the famous Caribou mine, which it adjoins. Several veins of practically pure silver, which run from 2 to 4 in. wide and a number of larger veins of ore that average from $20 to $140 per ton have been opened.

Breckenridge.—The Tonopah Placers Co. is prospecting near the northern edge of town with a Keystone drill, and, if results are favorable, ground on the west side of the Blue will be dredged. One dredge is now oprating profitably on the Blue river below the city.

Colorado Springs.—At the annual meeting of the Fanny Rawlins Mining Co., of Leadville, held in this city on last Monday, John Himebaugh was re-elected president for the thirteenth consecutive term, Alvin Perrine, vice-president, W. C. Frost, secretary. B. F. Webster, C. D. Hart, C. O. Giese, and H. A. Young complete the board of directors. The Leadville property, operated under the leasing system, is producing steadily.

Cripple Creek.—The Ajax Mines Leasing Co., operating the Ajax mine on Battle mountain, has made a rich discovery at the bottom or 20th level. Ore found on the main Ajax vein samples 15 to 18 oz. gold per ton.——A surface discovery of importance has been made by Louis Pelland, an old-timer of Cripple Creek, on the Cameron townsite at the eastern base of Bull hill. The vein, 2 ft. wide at a depth of 25 ft., samples 2 to 3 oz. gold per ton.

Idaho Springs.—A Denver syndicate has taken over the Gold Medal group and Wyoming Valley tunnel properties and arrangements have been made for extension of the tunnel traversing the Gold Medal.——A second shift has been put to work by the Surety Mining Co. on its Ute Creek property and development work will be continued during the winter months.

Montrose.—Reports have reached this city of a rich gold discovery made on Uncompahgre, on the Big Cimmaron river, by local prospectors—Alfred Harris, V. L. Miller, James Huffman, and James Viller. The men, completing assessment on their lode claims, are reported to have exposed a vein from which a sample assayed 150 oz. gold with a second vein, more than 4000 ft. distant, sampling 534 oz. gold and 46 oz. silver per ton. Several local mining men have left for the neighborhood of the discovery to stake claims.

Silverton.—Supplies have been sent in to the Holmgrain properties in Placer gulch, operated by the Hanson Peak Mining Co., and to the Queen City mine, where operations will be continued during the winter. Both properties are producing high-grade silver-lead ore.——Pack-trains are kept moving silver-lead ore down to Gladstone from the Joe & John mine, operated by the Golden Consolidated Mines Co.——Lessees on the Whale are shipping rich gold ore to the smelter.

Through the efforts of Herbert E. Curran, acting as receiver, Pittsburgh capital has been interested in the Kittimac mines in Minnie gulch. The work being done is under the direction of H. G. Brient. His preliminary investigations have proved encouraging. The property has within its boundaries several large gold-bearing lodes.

At Mineral Point, William A. Triplett has been active in the development of the London mines. One car of ore recently shipped from shallow deposits, consisting of galena and gray copper ores, is reported to be rich in silver, hand-samples of the lot carrying 70 oz. per ton.

J. B. Giono, operating parts of the Silver Lake mine of the A. S. & R. Co. under lease, has just shipped a car of ore assaying more than 8 oz. gold and 70 oz. silver, with 24% lead. The strike of rich ore of this character was entirely unexpected and has given an added encouragement to operations in Silver Lake basin.

IDAHO

Coeur d'Alene.—The International Mining & Metal Corporation, owning the Inland property in the north-west part of the Coeur d'Alene mineral belt, has resumed operations and let a contract for a 50-ft. extension of the drift on the vein, according to C. A. Gray. This drift is to follow the footwall side of the vein. The full face of the drift is quartz and siderite. The ore assays 6.8% copper, 1.4 oz. silver, and 0.04 oz. gold. The plan of development is to sink a winze 300 ft. deep on the vein near the end of the 300-ft. adit. Ore from the winze, which is down 10 ft., assays from $88 to $106 per ton in zinc, lead, silver, and copper.——With the organization of the Galena Mining Co., the Chicago-Boston Mining Co. and the Killbuck Mining Co. will pass out of existence. The Callahan Zinc-Lead Co. will control the new organization, as it did both of the others. The property lies a mile west of Wallace, and is being developed at the present time.

MISSOURI

Joplin.—The Indiana Mining Co., of Joplin, has filed articles of incorporation, with a capital stock of $150,000, of which $80,000 has been subscribed. The chief asset of the company is a mineral lease on a proved 80 acres, situated north of Carl Junction. F. H. Kissling, of Joplin, is the principal stockholder.

Sarcoxie.—Prospecting on the Pierce farm, north-east of this city, has resulted in a strike of an 18-ft. face of silicate zinc ore at a shallow depth. Drilling is proceeding, with no indication of exhaustion. The Pierce farm is new territory. On the Thomas place, east of the Pierce farm, there has been more extensive prospecting, interrupted to some extent by legal procedings regarding the rights of some of the prospectors. On the Solomon-Palmer lease, one mile south of Larussell, the finding of lead ore at 40 ft. is announced by the prospectors.

MONTANA

Butte.—In view of lower wage-scales now prevailing and reduced price of cyanide the East Butte company has resumed operations at its Elkhorn property, situated north of Butte. This property was developed several years ago primarily for the iron, which was used for fluxing purposes at the East Butte smelter but it was found that the ore carried gold averaging from $8 to $10 per ton. It is estimated that fully $500,000 of ore has already been uncovered. When the iron was no longer needed as a flux the property reverted to a strictly gold enterprise. During the War the property was closed down. A $500,000 mill was erected on the property several years ago, when developments had advanced to a point that warranted its construction. It is hoped to treat at least 250 tons of ore daily, so that East Butte should derive a substantial revenue from its operation.

NEVADA

Cherry Creek—A. Z. Smith, of Silverhorn, is opening the Exchequer mine under long-term lease. High-grade silver ore was recently found by the lessees when cutting a station in the shaft with a view to cross-cutting to the north vein on the 200-ft. level. The orebody, between 3 and 4 ft. wide, averages 52.5 oz. silver. Drifts run both ways on the vein for a distance of 15 ft. are still in high-grade ore, with no indication of the limits of the ore-shoot as yet in sight. Arrangements have been made to ship about 8 tons per day from the property to the American Smelting & Refining Co.'s plant at Garfield. Returns from a carload already shipped by the lessees from another portion of the property netted over $30 per ton, after freight, treatment, and royalty charges were deducted.

Ely.—Notwithstanding the fact that the Ely district mines are practically closed and the smelters idle, the future is promising. Since the shut-down of the mines, the Nevada Consolidated Co. has been developing what promises to be a very extensive body of high-grade copper ore, which was first discovered at Ruth about ten months ago. The ore, which is direct-smelting in character, assays 5 to 25% copper. The new body of ore is said to have been developed to a depth of more than 700 ft.; it is one of the largest bodies of high-grade copper ore discovered in recent years. And in addition to the discoveries and new bodies of ore blocked out by the Nevada Consolidated company, the Con-

solidated Coppermines and the Boston-Ely companies are now opening high-grade ore, the latter in the eastern end of the district.

It is said that in one section of the Ely Northern property there is now exposed a body of ore 18 ft. wide which will average around 15%. Still farther to the east, on the extreme limit of the range, Al. Meyers and associates, who have a lease on the Ely-Calumet property, are developing lead, copper, and zinc ores, which can be shipped to the smelters at a profit under ordinary freight-rates. The splendid results in these two properties naturally lend credit to the belief that the eastern end of the district will become important.

Pioche.—Development of the Alps mine to the east of Pioche is progressing satisfactorily, and already 10 tons of high-grade ore is ready for shipment. Assay of this material gives the following results: gold $6, silver 88.2 oz., and lead 40.5%. The ore is being mined principally from the east drift on the 200-ft. level, where the vein is narrow but rich. A raise put through where the vein widened is opening a satisfactory tonnage of milling ore, assays indicating a value of approximately $20 per ton in gold, silver, and lead.

Rochester.—A slight improvement over August in value of ore mined, in recovery, and in net operating profit is shown in the report for September of C. A. Bennett, general manager for the Rochester Silver Corporation. The tonnage treated was below that of the preceding month. In September the mill treated 4913 tons, as against 5271 tons in August. Metal contents of the ore were 0.147 oz. gold and 11.48 oz. silver, while in the preceding month these figures were respectively 0.159 and 10.66. New development work in September aggregated 540 ft. Bullion recovery in September was $59,298; total operating expense at mine, $39,439; gross operating profit, $19,858; and net operating profit, $18,431.

OKLAHOMA

Cardin.—In the face of adverse conditions, the lead and zinc mines of Cardin are paying $25,000 per week for labor, according to reliable estimates. This is one-fourth as much as the weekly payroll under war-time conditions. The average weekly check is about $21 and about 1200 miners find employment here. About 75% of the mines are operating. Two drill-rigs are being operated in West Cardin by the Commerce Mining & Royalty Co., which is prospecting new deposits. The Golden Rod Mining & Smelting Corporation keeps two rigs busy drilling in the west part of town.

The Croesus Mining Co. in Southeast Cardin has struck a large 'run' of lead in its upper level at 145 ft., which it has been developing for the last six weeks, according to W. H. Aul, superintendent. About 40 men are employed. The second level is at 208 ft. Operations were resumed on August 10.——The Victory Metal Co.'s mine in West Cardin has been operating for the last three months and is now on a double-shift basis, using about 60 men. They are working at a depth of 235 ft.——The Harrisburg No. 1 mill, owned by the Golden Rod interests, is operating, using about 60 miners. They are working at a depth of 200 feet.

OREGON

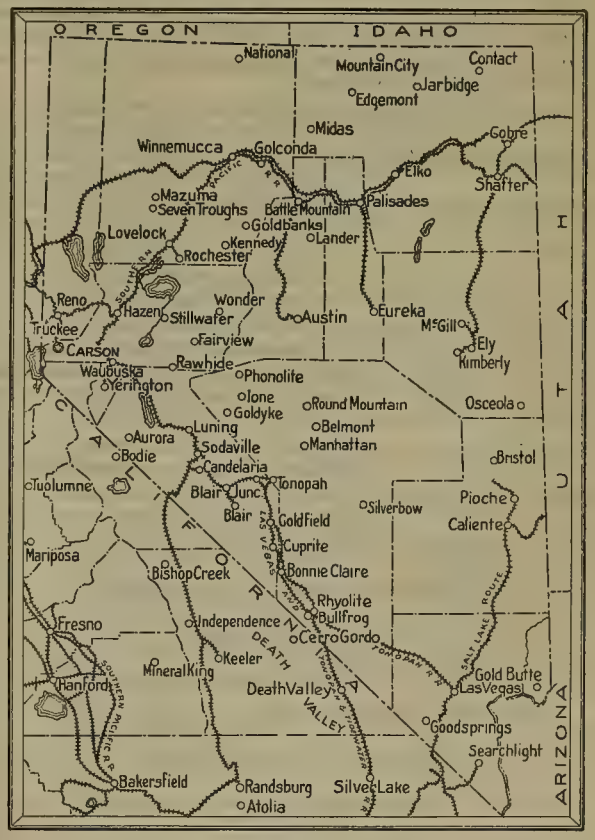
Huntington.—Reports from the Bay Horse mine on the Snake river, about eight miles below here, indicate that rich silver ore has been found. Recent samples gave results of 66.8 oz. silver, 164.8 oz.; 24.6 oz.; 32.4 oz.; 74.8 oz.; 189.6 oz.; 101.4 oz.; 172.0 oz.; with copper averaging about 1%. The property is only 84 miles from a custom smelter, this being at Sumpter, owned by the Sumpter Valley Smelter Co. It is expected the smelter will be ready to treat ore by the time the Bay Horse is prepared to mine and ship ore regularly. P. H. Millier is manager.

UTAH

Big Cottonwood Canyon.—Judgment against the East Carbonate Mining Co. for $701 was awarded Frank, Iver, Oscar, and John Forsman in a jury verdict returned before Judge Ephraim Hanson of the Third District Court on October 25. The money was owing the plaintiffs on a contract to drive a tunnel through the mining company's property.

The Cardiff Mining Co. is producing from 40 to 50 tons of ore per day, averaging from $45 to $55 per ton. Repairs are now under way at the ore-bins at the mouth of South Fork. During the winter season, the mining company stores its ore in these bins.

The American Metal Mines Co., which has acquired the holdings of the American Con. Copper Co. in South Fork,



Map of Nevada

has started deep development work. A number of strong veins, carrying silver and copper minerals, were prospected in the quartzite. These fissures are to be explored in the underlying limestone. The work will be done through a drift from the Victor Mines tunnel, which is about 550 ft. from the American company's line. The American Metal Mines has taken a lease and bond on a strip of Victor ground, 160 ft. wide, the purchase price to be $30,000.

Eureka.—A contract has been made between the Eureka Hill Mining Co. and Patrick Sheehan, covering the re-treatment of the tailing dump at the old Eureka Hill mill, which was one of the pioneer concentrating plants in this district. Jackson McChrystal, manager for the company, estimates that the dump contains 180,000 tons, averaging $1 in gold, 5 to 7 oz. in silver, 1.3% lead, and 0.2% copper. Sheehan and associates plan an up-to-date milling plant of 100 tons daily capacity. As to the method of treatment to be used, Sheehan is non-committal.

Ore shipments for the week ending October 22 totaled 172 cars, as compared with 142 carloads for the preceding week. The Tintic Standard shipped 70 cars; Chief Consolidated, 46; Victoria, 11; Iron Blossom, 7; Eagle & Blue Bell, 7; Grand Central, 6; Iron King, 6; Dragon, 4; Swansea, 4; Sunbeam, 3; Gemini, 2; Empire Mines, 2.

All work at the Grand Central mine is now being done by lessees, according to William D. Loose, superintendent. About 6 cars of ore per week is the average output. With the resumption of work at the Mammoth mine, adjoining the Grand Central, lessees in the latter property will be able to make greater headway by using the Mammoth workings for transporting ore and supplies.

A blower of a type similar to that used in coal mines will be installed immediately in the Water Lily shaft; it will have a capacity of 20,000 cu. ft. per minute. At a depth of 1200 ft. the shaft became filled with a heavy, hot gas, similar to that found in the Tintic Standard and other mines in the eastern part of the district.

At the Eureka Mines Co.'s property, a promising body of ore is being followed to the east on the 1000-ft. level. This deposit is believed to be the downward extension of the orebody opened on the 900-ft. level, according to Jackson McChrystal, manager. McChrystal states that present shipments average from 30 to 40 oz. silver and from 10 to 20% lead.

Grantsville.—Mining is being resumed in the Free Coinage district in the Stansbury mountains, about 9 miles from here. At the property of the Falk Mining Co., ore has been uncovered which gives returns of $27 per ton in gold, silver, and copper, according to report by J. T. Breckon, mining engineer. This property is controlled by K. H. Nordberg and associates.

Marysvale.—The American Consolidated Mines Co. has begun development of the I. X. L. mine in the Mount Baldy district, according to George H. Hamphill, manager. Operations have been started in Danielson tunnel. This adit follows an incline on the lime-quartzite contact. A sample taken in the tunnel gave returns of $1.60 in gold, 57 oz. silver, and 21% lead.——The Deer Trail Mining Co. is now employing 125 men, and treating from 100 to 125 tons of ore per day in its concentrating plant. Most of the ore now being milled is from development work.——At the Bully Boy mine 15 men are employed on development work.

Ophir.—Guy LaCoste, president of the Ophir Silver Mines Co., which lies to the east of the Ophir Hill property, reports that a tunnel is to be driven in Economy No. 13 claim. The tunnel will be for the purpose of deep development and to explore at depth a high-grade silver-lead orebody entered last fall on the 500-ft. level. A compressor and other machinery will be installed.

Park City.—Ore shipments for the week ending October 22 totaled 1886 tons, of which the Judge allied companies shipped 839; Silver King Coalition, 609; Ontario, 438. Shipments the previous week totaled 2190 tons.

Conditions continue to improve at the New Quincy property. A winze has been sunk for a distance of 75 ft. in a lime bed, with ore showing all the way. The winze is approximately 4000 ft. from the Little Bell shaft. The oreshoot is from 20 to 30 in. wide.

BRITISH COLUMBIA

Grand Forks.—A 10-ft. body of ore has been opened in the pyroxenite belt, locally known as the 'black lead', at Franklin camp. The ore assays 4.3% copper and 0.11 oz. of platinum per ton. William Thomlinson, while working for the Munition Resources Commission, demonstrated that platinum occurred in bunches and veinlets of chalcopyrite at a number of points in this belt, and last year the Provincial government operated a drill in the hope of finding ore. J. B. Singer has traced a 7-ft. vein for more than 1000 ft. on the White Swan group, which adjoins the Molly Gibson. A foot of this vein consistently assays $31 in gold per ton.

Nelson.—Wilfred A. Cameron, lessee for the Rambler-Cariboo mine, has taken a lease on the Molly Gibson mine, on Kokanee creek, from the Consolidated M. & S. Co. This mine should not be confused with the Molly Gibson, at Paulson, in the Grand Forks division. The Consolidated bought it several years ago, and operated it until the end of last February. During the two months that it was worked last year some 300 tons of silver-lead ore was shipped.——J. B. White, president of Silversmith Mines, Ltd., who with Spokane associates recently purchased the Bayonne group, has made an examination of the property. He states that only lack of transportation has prevented the Bayonne from becoming one of the leading gold mines of the Province. Three shifts are employed in driving a tunnel to cut the orebody at depth, and it is expected that by next spring the mine will be ready for a mill.

Rossland.—Eight lessees have struck a fabulously rich shoot of ore above No. 3 level in the I. X. L. mine, and 1704 lb. of ore sent to the Trail smelter gave a return of 156.48 oz. of gold. A raise has been put up for about 25 ft. on the shoot and a winze sunk about the same depth. The return is equal to about $1.90 per pound. Some 20 tons of cullings that probably will run $125 per ton have been mined. Similar ore is still showing at the top of the raise and the bottom of the winze. The I. X. L. is owned by John S. Baker, of Tacoma.

Trail.—Curtailment of operations at the Sullivan mine is reflected in the ore-receipts at the smelter for the week ended October 14, only 3185 tons being received. There were three independent shippers. The Consolidated M. & S. Co. recently shipped six cars of spelter to England by way of Panama.

MEXICO

El Oro.—A serious cave occurred between the 11th and 12th levels of the north shaft of the Mexico Mines of El Oro Mining Co. on October 19. Four miners, Rafael Franco, Trinidad Bolanos, Gregorio Martinez, and Crecencia Martinez are entombed below and are believed to be dead. As large a force as possible is being employed in clearing the shaft, but it will require some time to complete the work.

San Juan de Guadalupe.—An effort is being made to complete the spur running from Rivas station to the Calveritas mines to extend it to the foot of Sierra Ramires, when it will tap other rich mining districts. This line was built by Albert Genty for the purpose of transferring the ores from the Calveritas mines to Rivas station on the main line, and the Government is being requested to assist in extending it.

Louis Zuberia, an attorney resident of San Juan de Guadalupe and owner of a number of rich mines in this region, has re-located the old Solomon mine in the Reyes district. This property was recently forfeited by non-payment of taxes. It was formerly owned by Charles Mosler, who died a few years ago at El Paso. A body of high-grade silver-lead carbonates was at one time discovered in this mine which netted the owners over $20,000 within a short time.

Torreon.—The Asarco smelter, owned by the American Smelting & Refining Co., situated in the Velardeña district about 60 miles west of this city, is preparing to resume operations after being idle for about a year. It is expected that the plant will be running in full blast by the first of November. This plant has three copper- and three lead-furnaces.

Work of enlarging the Torreon smelter, owned by the Cia. Minera de Peñoles, is progressing rapidly and it is expected that the plant will be ready for operation by the first of the

year. The old furnaces are being torn out and replaced with others of larger capacity. The number will be the same as before—eight lead and one copper.

ONTARIO

Cobalt.—The improvement in silver-mining conditions is shown by the substantial increase in the number of men employed in the industry, as compared with the earlier months of the year. Fewer than 700 men were on the payrolls last February, whereas now there are over 1000 employed. Silver production is now maintained at a rate of about 800,000 oz. per month, as compared with about 600,000 oz. a few months ago.

The ore-shoot on the 530-ft. level of the Violet has been opened for 175 ft. with both faces in ore of a good grade. A winze is being put down 50 ft. on the vein, which will be drifted on at that depth.

Kirkland Lake.—The Lake Shore Mines, Ltd., has declared a dividend of 2%, amounting to $40,000, payable on November 10 to shareholders of record on November 1. During September, 1622 tons of ore netting $25.23 per ton was milled.

At the Teck-Hughes the big lens developed on the 4th level close to the Lake Shore boundary has been reached on the 5th level, where it shows increased enrichment, some of the ore extracted being stated to run as high as $60 per ton.——An electrically-driven plant has been installed on the Sylvanite and the first work undertaken will be the sinking of a 3-compartment shaft down to the 200 or 300-ft. level.

Porcupine.—The Dome Mines has issued a statement covering operations for the six months ending September 30, showing operating earnings of $432,137, and other income, $81,725, making a total of $513,863. Deductions of $369,712 for taxes, depreciation of plant, and depletion of mine left a total profit amounting to $144,151.——The occurrence of carbon in some of the ore found in the lower levels of the McIntyre has occasioned serious difficulties in connection with its treatment. Various solutions of the metallurgical problem presented have been attempted, and it is now believed that a process has been developed that can be successfully applied.

South Lorrain.—The ore-shoot recently cut at the Keeley mine has been found to have an average width of about 5 in. over a length of 32 ft. as far as opened, and is stated to assay about 4000 oz. of silver per ton.

Obituary

Stuart M. Thorne died at Toronto on October 3 as a result of a heart malady brought on by exposure while on active duty as an officer of the Canadian Engineers during the War. According to the 'Canadian Mining Journal', he was born in 1880, graduated from Toronto university, and later was connected with several mining enterprises in Canada. He was manager, among others, for the Silver Leaf, the Preston East Dome, and the Trethewey mines. In 1915 he resigned from the last named, and went overseas as Lieutenant in the Frist Tunneling Company; while in command of a section of this company, operating at St. Eloi in the Ypres salient, he prepared the largest of the 19 mines that were 'sprung' at the Battle of Messines, on June 7, 1919, winning both the Military Cross and the Croix de Guerre. After his company was merged with the new Battalion of Engineers he served with distinction during the hard fighting of the summer and autumn of 1918, in command of 'D' Company of the Fifth Battalion. In 1919 he returned to Canada with the rank of Major, and resumed the practice of his profession, but his health had been permanently impaired, necessitating his retirement last May.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

T. A. Rickard is at Rolla, Missouri.

John Hays Hammond is at the Fairmont hotel.

A. G. Mackenzie has returned to Salt Lake City from New York.

M. W. Summerhayes has returned to Canada from California.

J. H. Rose has moved from Winthrop, California, to Mina, Nevada.

Edward Thornton has returned to Los Angeles from Hermosillo, Mexico.

Benjamin B. Thayer has returned to New York from Butte, Montana.

Fred V. Burns has moved from Tampico, Mexico, to Houston, Texas.

M. B. Parker has moved from Hollywood to Johannesburg, California.

H. R. Plate has returned to San Francisco from Sheepranch, California.

Charles Bocking, manager for the Butte & Superior Mining Co., is in New York.

W. F. Boericke, of Galena, Illinois, has been at Kingman, and is now in San Francisco.

J. I. Brown has changed his address from Seattle, Washington, to Cripple Creek, Colorado.

Erle Huntley has been appointed general manager for the Laloki Copper Mines Co., of Papua.

Horace G. Nichols has returned to Vancouver, B. C., after spending three months in the Liard region.

George D. Blood, manager for the Park-Utah Mining Co. at Park City, is in California for a short hol day.

C. Powell Karr has been appointed a member of the engineering committee of the National Research Council.

R. H. Hawley, superintendent of the leaching-plant of the Utah Copper Co., at Magna, Utah, is at Kansas City, Missouri.

H. C. Carlisle, of Tonopah, Nevada, general superintendent for the Nevada Wonder Mining Co., is at Douglas, Arizona.

Louis A. Wright expects to return to the United States from Obermais, Merano, Italy, by way of New York, about December 1.

O. M. Kuchs sailed from New York on October 26 for Chile to take over the general management of the Andes Copper Mining Co.

John C. Febles has been appointed general superintendent for the Boston & Montana Revelopment Co., at Wise River, Montana.

J. A. Pearce left Berkeley, California, on October 28, to do some metallurgical work for the Cia. del Boleo, at La Paz, Baja California, Mexico.

Alexander McFarland, mine superintendent of the Seoul Mining Co., Korea, will act as general manager for the company during **A. R. Weigall's** absence in the United States.

Walter G. Scott, who has been metallurgist at the Southwest Station of the U. S. Bureau of Mines, has returned to the Inspiration Consolidated Copper Co., at Miami, Arizona.

Howard R. Ward, mining engineer of New York, and **Errol MacBoyle,** of San Francisco, are at Alama, Baja California, Mexico, in the interest of the International Minerals Syndicate.

J. O. Elton has been appointed assistant general manager for the International Smelting Co. He was recently at the Great Falls smelter of the Anaconda Copper Mining Co., as assistant manager.

THE METAL MARKET

METAL PRICES

San Francisco, November 1

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.25
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

October 31.—Copper is more active and stronger. Lead is quiet and firm. Zinc is dull and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Oct. 25	68.62	39.12	Sept. 19	65.14	39.56
" 26	69.37	39.62	" 26	67.68	40.96
" 27	69.75	40.00	Oct. 3	71.07	42.89
" 28	70.75	40.87	" 10	70.73	42.06
" 29	71.00	41.12	" 17	72.97	42.57
" 30 Sunday			" 24	70.64	40.52
" 31	70.75	40.75	" 31	70.04	40.25

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59 90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Oct. 25	12.75	Sept. 19	12.08
" 26	12.62	" 26	12.12
" 27	12.62	Oct. 3	12.21
" 28	12.62	" 10	12.64
" 29	12.75	" 17	12.80
" 30 Sunday		" 24	12.69
" 31	12.75	" 31	12.68

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	...
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Oct. 25	4.70	Sept. 19	4.60
" 26	4.70	" 26	4.68
" 27	4.70	Oct. 3	4.70
" 28	4.70	" 10	4.70
" 29	4.70	" 17	4.70
" 30 Sunday		" 24	4.70
" 31	4.70	" 31	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4 96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62 74	35 94	July	70.11	49 29	27 69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch	72.50	61.92	28 87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40 47	...
May	72 50	54.99	32.50	Nov.	54 17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34 12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Oct. 25	5.10	Sept. 19	4.70
" 26	5.10	" 26	4.73
" 27	5.10	Oct. 3	4.94
" 28	5.05	" 10	4.74
" 29	5.05	" 17	5.12
" 30 Sunday		" 24	5.14
" 31	5.05	" 31	5.07

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4 89
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	.
June	6.91	7.92	4.96	Dec.	8.00	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Oct. 4	47.50	Oct. 18	47.50
" 11	47.50	" 25	42 50
		Nov. 1	42.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

MEASURES RECOMMENDED BY THE PRESIDENT'S CONFERENCE FOR PERMANENT RECOVERY OF EMPLOYMENT

Recovery of our industry and employment must necessarily be a process of gradual healing of the great economic wounds of the World War. This healing is making distinct progress.

Without attempting the impossible task of assessing the relative weight of different forces, the conference presents the following summary of the more important matters that require constructive and immediate settlement, if recovery in business and permanent employment are to be more expeditiously accomplished.

1. Readjustment of railway-rates to a fairer basis of the relative value of commodities, with special consideration of the rates upon primary commodities, at the same time safeguarding the financial stability of the railways.

2. Speedy completion of the tax bill, with its contemplated reduction of taxes, in order that business now held back pending definite determination may proceed.

3. Definite settlement of tariff legislation, in order that business may determine its future conduct and policies.

4. Settlement of the financial relationships between the Government and the railways, having in mind the immediate necessity for increased maintenance and betterments, making effective increased railway employment and stimulation of general employment, in order that the railways may be prepared for enlarged business as it comes.

5. Limitation of world armament and consequent increase of tranquility and further decrease of the tax burden, not only of the United States but of other countries.

6. Steps looking to the minimizing of fluctuations in exchange, because recovery from the great slump in exports (due to the economic situation in Europe) cannot make substantial progress so long as extravagant daily fluctuations continue in foreign exchange, for no merchant can determine the delivery cost of any international shipment.

7. Definite programs of action that will lead to elimination of waste and more regular employment in seasonal and intermittent industries, notably in the coal industry, in order that the drain upon capital may be lessened and the annual income of workers may be increased.

8. In all the different industries and occupations the rapidity of recovery will depend greatly upon the speed of proportionate adjustment of the inequalities in deflation.

If the buying power of the different elements of the community is to be restored, then these levels must reach nearer a relative plane. For example, the farmer cannot resume his full consuming power and thus give increased employment to the other industries until either his prices increase or until more of the other products and services come into fair balance with his commodities, and therefore within the reach of his income.

MONEY AND EXCHANGE

Foreign quotations on November 1 are as follows:

Sterling, dollars:	Cable	3.93
	Demand	3.93½
Franc, cents:	Cable	7.43
	Demand	7 45
Lira, cents:	Demand	4.11
Mark, cents:		0 59

Eastern Metal Market

New York, October 26.

Steadiness but not much activity characterizes nearly all the markets.

Demand for copper is moderate with prices steady.

Sales of Straits tin continues and prices are higher.

The lead market is quiet and steady.

There is less activity in the zinc market and quotations are a little lower.

Antimony is weaker.

IRON AND STEEL

The controlling factor in the steel industry now is the expectation by buyers of a reduction in freight-rates, and this has put a damper on buying. The reduction in the price of steel rails by the Steel Corporation has been a factor also.

The Steel Corporation's statement of earnings in the third quarter of the year, like its predecessor, reflected a larger scale of operations than at most independent works; also the benefits of operations in all producing districts and the importance of certain by-products. Net earnings came within $600,000 of paying the preferred dividend; this was unexpectedly favorable.

In reducing steel rails from $47 to $40 per gross ton the Steel Corporation directly points to "reductions in freight-rates and otherwise, together with larger operations" as its dependence for the reduction of its costs. For "larger operations" the railroads must needs release some hundreds of thousands of tons of 1921 rails that have been 'frozen' on rail-mill books and to which the reduced price will now apply. In addition, free buying of rails for 1922 is confidently looked for. That independent rail-mills will follow the Steel Corporation's reduction is to be expected.

COPPER

While demand has slackened and the market is by no means as active as it has been, the situation is regarded with satisfaction by most sellers. The electrolytic market is holding well at recently established levels, which is pointed to as a good sign. In some buying movements prices have attained heights which could not later be maintained, much to the detriment of the trade, but in this case this has not taken place. Electrolytic copper for early or November delivery is quoted at 13c., delivered, or 12.75c., New York, though this price was shaded in a few transactions last week. The market seems firm now at this level. Buying for foreign consumption is good, particularly by the Far East and by France and England. Germany is not as active as formerly.

TIN

The past week has again been featured by moderate sales of Straits tin. A peculiarity of these transactions, however, has been that the buying, participated in by both dealers and consumers, has ignored the intermediate positions and confined itself to spot and far-future delivery. The bulk of the business was put through for November-December and December-January shipment from the East with considerable spot business included. The latter may have been due to fears of a railroad strike. Prices, covering the sales referred to, ranged from 28c. for spot to 29c. for far-futures. Yesterday the quotation for spot Straits tin was 28.50c., New York, as compared with 28c. last week. The London market yesterday was quoted at £156 10s. for spot standard, £158 15s. for far-future standard, and £157 per ton for spot Straits or slightly under those a week ago. Prices for American pure tin are reported as close to those of Straits tin, New York. Arrivals thus far this month have been 1900 tons with 3150 tons reported afloat.

LEAD

Except for an easing in the price situation at St. Louis there is no change in the market. Demand continues satisfactory at 4.70c., New York, but at St. Louis quotations are lower at 4.40 to 4.45c. On the whole the market may be described as steady, quiet, and firm.

ZINC

There is less activity; demand from galvanizers has largely abated. Conditions have caused a slightly easier market in which one or two sellers are offering prime Western at 4.60c., St. Louis, or 5.10c., New York, at which level some business is reported. At any rate it seems that the present light demand can be satisfied by the limited amount thus available. Most producers are either asking more or not quoting.

ANTIMONY

Wholesale lots for early delivery are quoted lower at 4.85c., New York, duty paid, the weakness being ascribed to offerings of lots afloat. Jobbing lots are quoted at 5 to 5.25c.

ALUMINUM

Virgin metal, 98 to 99% pure, is unchanged in an inactive market with 24.50c. f.o.b. plant, asked by the leading producer. The same grade is offered by importers at 17 to 18c., New York, duty paid.

ORES

Tungsten: Conditions are unchanged and quotations are nominal at $2.75 to $3.50 per unit, depending on the grade and the quantity.

Molybdenum: Nominal quotations still rule in an inactive market at 48 to 50c. per pound of molybdenum sulphide in regular concentrates.

Manganese: There is no activity with quotations still nominal at 20c. per unit, seaboard, for high-grade foreign ores. Imports in September were 10,402 gross tons bringing the total for the year to October 1 to 336,744 tons against 423,012 tons to October 1, 1920.

Chrome: The market is flat with one seller quoting foreign chrome ores at $20 to $26 per net ton, Atlantic ports, nominal, and depending on analysis.

FERRO-ALLOYS

Ferro-manganese: There is no change in the quotations of both British and American products on a basis of $58.35 per ton, Atlantic seaboard. There is also no demand. Imports in September were 804 tons and the total for the first nine months of this year is 6605 tons against 40,039 tons to October 1, 1920.

Spiegeleisen: The market is devoid of feature with quotations unchanged at $25 to $26, furnace, for the 19 to 21% grade.

Ferro-tungsten: The standard domestic alloy is quoted nominal at 40 to 45c. per pound of contained tungsten, f.o.b. plant, while the foreign alloy is quoted at 50c., duty paid, seaboard.

Ferro-silicon: The market for 50% ferro-silicon has recently been broken to $55 to $57, delivered, from one small producer.

Ferro-chromium: This market has weakened decidedly until regular 60 to 70% alloy, containing 4 to 6% or 6 to 8% carbon, can be bought as low as 10 to 11c. per pound of contained chromium in wholesale lots.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.25 to 1.50
" " " " " carboys "	2.25 to 2.75
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	7.75 to 8.75
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27½
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.25 to 6.00
" powdered, in barrels "	5.50 to 6.50
" glass ground, 30 mesh, cases, tin lined, per 100 lb	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	0.31
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per ton	80.00
Manganese di-oxide, bulk, Caucasian (85% MnO_2 – 7% Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.16½
" " " " granular " "	0.16½
" " " " powdered " "	0.17½
" carbonate, calcined, in barrel lots, per lb	0.25
" permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.00 to 3.50
" bicarbonate of " "	3.00 to 3.50
" caustic, ground, 98% " "	6.50
" " solid " " "	5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	11.05
" " " 2-in. "	34.80
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.70
" " " 10, triple-braid, weather-proof, coil lots per 100 lb	21.50
" " " 14, single-braid, rubber-covered " per 1000 ft	7.35
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.20
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60 666, per 100	25.20
Telephone wire, iron, size 12, half-mile lots, per 100 lb	8.75

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.00
" gelatine " " "	19.00
" ammonia " " "	18.00
Fuse, common, in case lots, per 1000 ft	7.20
" waterproof, triple tape, in case lots, per 1000 ft	9.01

FUELS

Coal, Utah steam, $4 at mine, plus $7.50 freight to California terminal points in carload lots, per ton	11.50
Coal, blacksmith's, in carload lots, per ton	24.00
" " in small lots, per ton	27.00
Coke, in carload lots per ton	25.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate "	0.16½
Gasoline " "	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine "	0.42½
Brass sheets, half-hard and soft, per pound	0.24½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅝ by 2-in., per 100 lb	8.15
Nails and spikes (20d to 60d base), per keg	4.90
Nuts, hot pressed, ⅝-in., hexagonal, per 100 lb	9.45
" cold punched " "	11.25
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, per 100 lb	5.50

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.75
Rails, steel, 8 to 25-lb., per 100 lb	3.99
Reinforcing-steel, per 100 lb	3.75
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.55
" flat " " " "	6.45
" flat, black iron " "	5.90
Structural T's, channels, angles, and beams "	3.85
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	6.50
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	12.40
" " galvanized " "	15.70
" " black " 4-in. "	52.45
" " " extra strong " "	95.25
Shafting, cold-rolled (2⅛ to 3-in. base) "	5.50

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
" " extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	75.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M	200.00
White pine " " " "	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.00
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.16
" " " 2 (standard), per pound	0.15
Packing, flax, per pound	0.33 to 0.85
" sheet "	0.25 to 1.00
" steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	41.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	32.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.00
" sheet, 36 in. by 84 in., No. 9 gauge, in tons lots, per 100 lb	13.50

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots, Livermore Star Brand	55.75
Fire-clay, in bags, per ton	18.00
Lime, lump in barrels, per barrel of 180 lb	2.65
Portland cement, in bags, per barrel of 380 lb	3.95
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	4.55
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	10 to 15
Feldspar, crude, lump free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluorids, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 7c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness and cleavage, per pound	1 to 8
Molybdenite not less than 85% free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump white, per ton	7.50 to 10
Tin ore not less than 60% Sn, per % Sn	4 to 6
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

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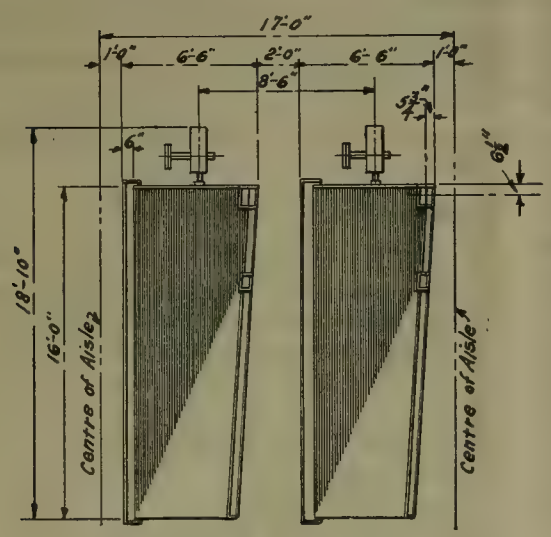

Arrangement of Two Left Hand Tables
Right Hand Tables Opposite

Wilfley

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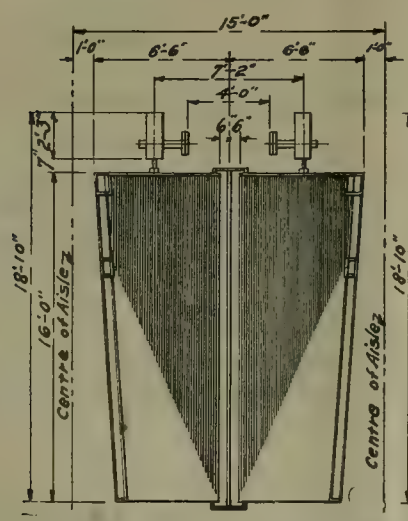

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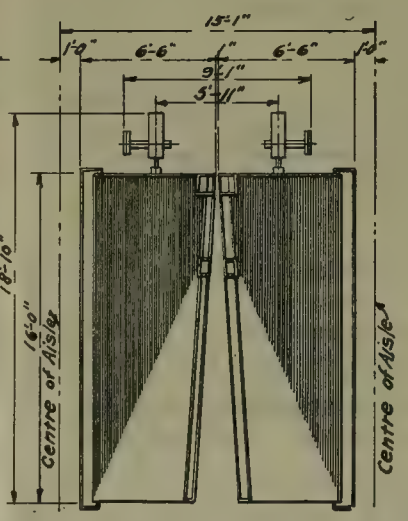

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T. A. RICKARD, - - - - Editor

UNDER 'Discussion' we publish a contribution on the subject of recreation for the workers in mines and factories. The writer, Mr. P. B. McDonald, a graduate of the Michigan College of Mines, is the Assistant Professor of English in the College of Engineering of New York University, and he ought to be able to teach his subject well, judging by his own care and skill in writing. We welcome his letter as an example of scholarly expression and also for its substance, for the subject of a proper kind of recreation for industrial workers is well worthy of serious study.

WARREN NORRIS, a pharmacist at Bisbee, Arizona, recently suggested to the manufacturers of 'Eversharp' pencils that copper would be a splendid material to use in the making of their specialty; the idea was accepted at once. The metal is given a simple treatment that enables it to retain its lustre, and an attractive article is the result. It is true that a great many such pencils would be required to consume the existing surplus of copper, but if everyone whose prosperity, like that of Mr. Norris, depends on copper mining could contribute an idea equally good, conditions would improve quickly. The ocean itself is composed of drops of water.

WE are prepared to credit the successful politician with the possession of a large measure of genius; not one man in a thousand can step out of any other walk of life and successfully steer a serene and steady course to political preferment. Generally the real politician is a specialist; his training started, unknown to himself, in grammar-school. Later, the idea of entering politics took shape; if he had the ambition to rise to State or national fame, he studied law—that being the approved preparation for a political career. Perhaps circumstance compelled him to follow his profession at first, but at the same time he schooled himself in the 'art' of politics until the opportunity came for grasping a rung not too far from the bottom of the political ladder. If he had the native ability and had absorbed the innumerable subtleties of the 'game', if he had studied the science of keeping on the right side of the 'peepul' and the technique of getting votes, he climbed rapidly. But occasionally it happens that a man is plucked from some other sphere of life and is dropped suddenly into the political arena; a specific instance of this is the election, a year ago, of Mr. Samuel S. Arentz as Congressman-at-large from the State of Nevada. Mr. Arentz primarily is a mining engineer, and a successful one, we happen to know; but as a politician he has, or at least had, much to learn. It seems that, some months after his succession to office, he received a bundle of photostats reproduced from the draft of the proposed new Mining Code, drawn by the now well-known committee of engineers at the instance of the Bureau of Mines. It was suggested that, being a new member from one of the leading mining States, he might be glad to introduce a bill incorporating the proposed code. Mr. Arentz, who apparently had mastered one of the first principles of politics—the value of advertising—welcomed the idea and directed his clerk to draw-up, in proper form, the document now known as the Arentz Bill. Not every new Representative is accorded the honor of introducing a bill under his own name within a year after his election; the world would necessarily look upon the well-drawn bill as the child of Mr. Arentz's brain and would pay due homage, irrespective of what his personal views on the measure might be. The Arentz bill went forth; it was published, among other places, in every weekly paper in Nevada; and there it raised a storm of protest among the prospectors and small mine-owners. Recently an indignation meeting was held at Reno, at which the bill was condemned without qualification. Now it should be known that Mr. Arentz's friends regard him as being promising material for United States Senator from Nevada; wherefore this tactical error in introducing the mining bill was most grievous. However, next to the ability to avoid the necessity for making explanations, the ability to make explanations is the politician's greatest asset; so Mr. Arentz writes home to his constituents that he introduced the bill for the reason that he believed that his position as apparent sponsor would enable him most effectively to accomplish its defeat. The explanation, we believe, marks Mr. Arentz as a suitable candidate for Senator.

ADDRESSING the recent convention of the American Mining Congress, Mr. W. J. Loring, the president, in discussing blue-sky legislation, declared: "It is typical of Americans not to want a sure thing. Take away from the public the right to take a risk, and you imperil the progress of the mining industry which has been built by men who were willing to stake all. I am against the idea

of a regulative bureau; it is well intentioned, but wrong''. To us it seems that Mr. Loring's reasoning is at fault. His expressed conviction is not the logical result of his premise. The purpose of well-considered blue-sky laws is to see that the public has 'a run for its money'—to prevent unscrupulous promoters from playing a 'sure thing' and taking the money of ignorant but honest speculators, without giving them even a gambler's chance. The miner has always worshipped at the shrine of the Goddess of Fortune. When all the cards are on the table, mining is at best a gamble; when the deck is stacked by dishonest promoters, the outsider is up against a 'sure thing'.

EMPLOYER and employee are certainly at loggerheads when every action on the part of one faction is the object of mistrust and suspicion by the other, and when the correctness of every statement, the truth of which is not obvious, is doubted. The recent history of the wages dispute at the Mount Morgan copper-gold mine in Queensland, Australia, provides a lamentable exhibition of such a spirit. The decline in the price of copper late last year prompted a conference between the general manager and representatives of the various unions, at which it was explained that a resumption of operations would have involved a loss of about £2300 per week. The general manager told the men that the company could not face this with equanimity, and proposed a reduction of 20% in the current rate of wages, and the resumption of work; the delegates' reply suggested referring the matter to the Arbitration Court. A conference was then called, after which the unions proposed that the men should be paid 80% of the existing rates and given deferred-wages certificates for the remaining 20%, the latter to represent monies that would be payable as soon as the company was earning a profit. The general manager replied that the suggestion offered no solution of the difficulty, for it did not reduce the cost of operations; the company proposed, as an alternative, a sliding scale of wages, based on the price of metals; this was rejected by the unions. At this stage it was evident that no agreement could be reached without what is commonly known as a 'show-down'; for the men were suspicious of the good faith and truthfulness of their employers. At the instigation of the unions an application was filed with the Industrial Court for an investigation of the figures given by the company as to the cost of producing copper. An official order was then made to a firm of accountants to examine the books, to prepare the necessary schedules, and to report to the Court. In due course the accountants' finding was made; it showed that, under the then existing rate of wages, the price paid for copper would have to be over £92 per ton if the cost of production was not to exceed the receipts. The verdict, instead of helping the case for the unions, showed that the company had been unwisely generous in its terms; for had its offer (of a 20% reduction in wages) been accepted, operations could only have been continued at a loss to the stockholders. This example is one of many that may be cited to prove that the employee often maintains an attitude of unfounded mistrust toward his employer. The friction that results is one of the principal causes of the hindered settlement of industrial disputes.

RESEARCH is a word that has been subjected to the usual maltreatment at the hands of many who are not qualified to undertake the work involved in a search for facts and principles that is prolonged and diligent, the result of which is a scientific achievement. At a recent meeting of the American Society for Steel Testing, Mr. E. P. Hyde divided such work into scientific research and engineering research. The former may be pure or applied; it may be further divided into frontier research and co-operative research. Applied scientific research is an industrial effort. Under the heading of 'engineering', Mr. Hyde details engineering research and engineering practice. Our contemporary 'Chemical and Metallurgical Engineering' makes some admirable comments on the subject in recent issues; it protests that all five classes in Mr. Hyde's outline cannot be designated as varieties of research. To this we agree. Scientific research is the foundation of all advance; it heralds the discovery of a new and hitherto unknown fact. The scientist must be a free agent; various instrumentalities are now bestirring themselves to encourage him in his work, and they should bear this fact in mind. They should see that the research professor receives a salary that will enable him to live without grinding economy; he should be relieved of petty administrative details, and then left alone to make his discoveries; his researches are needed to furnish the fundamental basis of scientific and engineering progress. Then comes the examination from all angles, the devising of applications, and the testing of materials, the last-named being merely experimentation. Research, says our contemporary, may be likened to a voyage of discovery. Land is reached; then comes the task of making maps, followed by the building of roads; the fields are cultivated and the natural resources are exploited; lastly, when adequate settlement is an accomplished fact, comes the necessity for crop rotation and for fertilization. It is a far cry from the trackless forest to the truck-garden. We agree. The sloppy and occasionally dishonest use of key-words is becoming too common. Research is an indication of painstaking effort to add to the sum of human knowledge; but the term is often usurped by the hit-or-miss experimenter, or by the investigator whose 'researches', as indicated by voluminous writings, fail to carry conviction or to indicate the possession of a creative spirit of invention.

THE metric system has a staunch supporter in Mr. Huntington Adams, whose connection with the introduction, in Mexico, of an important development in cyanidation—continuous agitation in Pachuca vats—will be recalled. Mr. Adams, whose letter on the introduction into the United States of the metric system of weights and measures appears on another page of this issue,

speaks from a personal engineering experience in various countries where the system is or is not compulsory. Such opinions are of value, if only to combat the anti-metric propaganda that is so insular in its viewpoint. Mr. Adams gives an excellent summary of the conditions throughout the world in so far as the prospect of uniformity in this respect is concerned; he emphasizes the tendency on the part of those of British race to discountenance any change from long-established methods and customs, citing the riots that occurred in London in 1752 because the Government desired to correct the error of the old Gregorian calendar by the deletion of 11 days in the month of September. We welcome further comment on this most important question of conformity to a world's standard of weights and measures, as important to ourselves as to our descendants. The opponents to the introduction of the metric system harp on the cost of the change to the manufacturer, which suggests that the propaganda is being subsidized in favor of a group or groups. However, we understand that manufacturers are exempt from the provisions of the bill now before Congress; they are at liberty to change their standards to that of the metric system if they desire; there is no compulsion about it. The initiative will doubtless be taken by a few progressive firms as soon as the proposed legislation becomes law, the result being that there will be an early evidence in their works and factories of an increase in efficiency and a saving in labor. This will place those manufacturers at an advantage; the general adoption of the metric system will then be inevitable. Industrial corporations balk at the expense, which should be nominal in most cases; such expenditure is purely optional, but having once been made it will, we believe, prove to have been a sound and profitable investment. Other contributions to the discussion columns in this issue include Mr. S. A. Knapp's views on the restoration of bimetallism. He argues that the enactment of a Free Coinage Act, making silver one-sixteenth the value of gold, would restore the metal to parity throughout the world, especially if joint action to this effect could be taken with Canada and Mexico. Mr. Samuel H. Dolbear writes from New York on the respective characteristics of wetting and amalgamation. Mr. Edgar Hall discusses the element of time in cyanidation, quoting an instance in which this factor was disregarded when interpreting experimental results. Various explanations have followed the almost inevitable failure to treat silver ore by a gravity leaching process, but the fact remains that all-sliming is essential if an adequate extraction of the metal is to be expected.

Osmiridium

With the decrease in the production of gold, attention is being paid to the value and utility of the rarer metals. Among these may be mentioned osmium and iridium, or their natural alloy, osmiridium, which is used, in minute individual quantities, for fountain-pen points and for the bearings of delicate and sensitive instruments. Iridium was being sold for as high as $400 per ounce late in 1919; it is now worth about $165 per ounce. A few hundred ounces of this metal is recovered annually during the refining of gold bullion, nickel, and copper in the United States; a little more of osmiridium is obtained from the same source. Imports of the latter into this country increased from 259 ounces in 1917 to 427 ounces in 1918, 1374 ounces in 1919, and 4473 ounces in 1920. The precious alloy has been found in the concentrate that remains after 'cleaning up' the sluices that are used in hydraulic mines; the amount recovered is small, so the production of osmiridium from this source is negligible. More recently, however, attention has been paid to the occurrence of the alloy in Papua, formerly British New Guinea. There it occurs in association with gold, as well as in the free state; it was formerly discarded, as it was also in Tasmania, where the miners looked upon it as a nuisance. Their confreres in Papua, whose 'gold' contained osmiridium, found, on selling their bullion, that they were penalized. The more precious alloy was classed among the base metals, the mint authorities objecting to its presence in the bullion because of the resultant defacement of the dies used in coining.

When free, osmiridium occurs in a flaky form and also in shot-like granules. Recently the 'Daily Mail' described the arrival in London from Papua of a small consignment of the alloy, weighing about 2½ pounds, which was eagerly bought for £1200 by the representative of an American firm. The story of the first discovery of osmiridium is also recounted. It appears that a small group of prospectors, who were washing gravel in one of the river-beds, noticed a bluish-gray metallic substance in the pan, but, in their eagerness to find the yellow metal, they threw it away as valueless. On returning to the settlement they mentioned the occurrence to a mining engineer, who exclaimed, "It must be osmiridium". The next morning the party returned to the spot, only to find that the tropic rains and the swollen river had washed most of it away. What remained was carefully recovered, cleaned, and dispatched to London, where it found a ready sale at a fabulous price. New Guinea consists of virgin territory, almost unscratched by the prospector, and undeveloped by the engineer. It is possible that it may become an important source of precious and rare metals.

Second-Hand Equipment

Many maintain that it is an ill wind that blows nobody any good. In a report upon the low-grade mines on the Witwatersrand, the Government commission that was appointed to study the question of economical operation commented on the difficulty and expense of securing machinery for new mines, and stated that the cessation of operations at some of the low-grade properties would enable mining companies to secure suitable equipment at reasonable prices and promptly. Mr. R. C. Atkinson, in his inaugural address before the South African Institute of Engineers, gives some pertinent arguments

against the use of second-hand machinery, and draws attention to many points of interest that usually escape the consideration of the buyer. Those who have had experience in the purchase, dismantling, transport, and re-erection of such equipment will probably agree with him that the idea is not so attractive as would appear at first sight. The plant, having been in operation for a number of years, probably will possess mechanical and metallurgical features that have been superseded; such must be modified if the latest practice is to be adopted. It is conceivable that the alterations involved may entail the re-arrangement of the various units; this, in turn, will affect the network of connecting links, such as classifiers, launders, pipes, pumps, and elevators. In other words, the plant cannot be dismantled and re-erected as before, piece by piece, each fitting in its place, as some imagine. In order to obtain the highest extraction compatible with low costs, such equipment can only be used in conjunction with more up-to-date units, appliances, and methods. The original drawings of plant that has been in operation for some time, even if obtainable, are of little use in regard to an alternative arrangement of units; if, as happens not infrequently, alterations have been made, or should departures have been adopted from practice indicated by the drawings furnished when the plant was first put in commission, which are not shown therein, the matter is complicated still further. Thus the work in the drawing-office may exceed that required for a new plant. In the latter case it is merely a matter of referring to the existing drawings and to data of recent equipment in order to decide what alterations or improvements are necessary to modernize the installation. In the case of the second-hand mill, this becomes an operation that is difficult in proportion to the number of years that have elapsed since the plant was designed. Thus it is that the preliminary work, before re-erection is commenced, is considerable and involved; little saving, if any, is effected by disregarding the advantages of new equipment. Furthermore, the dismantling of second-hand machinery may, and often does, reveal defects that could not be discerned by such inspection as usually is permitted before purchase; these, coupled with the losses and breakages that are inevitable, must be taken into account; the largest item is invariably on account of repairs and renewals, due to such defects. In the case of a mill, a careful examination before purchase will reveal, more or less, what expenditure is necessary to re-condition the plant; and a close approximation can usually be made as to the amount required. New foundations must be provided, however; and these will cost as much as would new equipment. But units such as tanks, vats, pumps, compressors, boilers, condensers, and economizers, which cannot be examined internally before the sale, are often a disappointment if purchased second-hand. Tanks and vats, of which the parts above ground are in good condition, may require new bottoms; pumps may need new spindles and new liners, or the shells may be badly corroded or worn; boilers may need new tubes; the cylinders of engines or compressors often require re-boring; and new pistons, piston-rings, and other parts must be purchased or manufactured. By this time the original estimate of saving may have been reduced to insignificant proportions, or the investment may be considered as thoroughly unsatisfactory. Moreover, the maintenance costs of a re-conditioned plant are often much higher than is the case with a new plant. We are inclined to agree with Mr. Atkinson that the acquisition of second-hand equipment is seldom good business.

Mining in Russia

As our readers are aware, an effort has been made recently on the part of the Russo-Asiatic Corporation, a British mining company with which several distinguished American mining engineers are connected, to resume operations at its properties in Siberia. The negotiations were conducted for the company by Mr. Leslie Urquhart, the chairman, and for the Soviet government by Mr. Leonid B. Krassin, of the Russian Trade Delegation, an agency established for the purpose of facilitating the resumption of foreign enterprise in Russia. After lengthy negotiations, conducted partly in London and partly in Moscow, it has been found impossible to arrive at a settlement. We publish Mr. Urquhart's letter to the shareholders, as well as his letter to Mr. Krassin, both being printed verbatim because they are documents of great interest, as throwing a lurid light on the real economic plight of Russia at this time; it seems to us that the facts in this case are worth more than half a dozen magazine articles by economists and sentimentalists. The mining profession in the United States is interested in the matter because many of our engineers are connected, or have been connected, with Russian mining enterprises. Among those in the employ of the Russo-Asiatic Corporation are Messrs. R. Gilman Brown, H. H. Knox, T. J. Jones, D. P. Mitchell, and A. W. Stickney. Besides these, Messrs. H. C. Hoover, Theodore J. Hoover, A. C. Beatty, and J. Power Hutchins have been interested in important operations in Siberia. Therefore the prospects of a resumption of profitable activity are of more than academic or sociologic interest. Mr. Urquhart conducted his part of the negotiations in a tactful and amicable manner, we feel sure, for he has a high reputation as an unofficial diplomat, having spent a part of his early life in Russia, so that he speaks the language well and knows the people intimately. Mr. Krassin, likewise, seems to have done his best, but the chaos of social muddle and political mismanagement has proved too much for both. No further comment is necessary; we invite our readers to study the evidence. It remains only to note the pathetic fact that the laborers and other employees on the Russo-Asiatic properties, which include mines, smelters, and factories, were anxiously hoping that a resumption of work would ensue; many of them sent personal messages of goodwill to Mr. Urquhart. It is evident that the action of the Soviet authorities will be a blow to that restoration of industry upon which the salvation of Russia depends.

The Problem of Recreation

The Editor:

Sir—One of the great problems in industry today, though perhaps it is not clearly recognized as such, is that of recreation. The men and women working in the busy factories and mines of our land need recreation. Our forefathers did not require recreation as such because their work was varied and leisurely; it was something of an adventure in itself. Today work in industry has been standardized, subdivided, and mechanized. One man feeds a machine, another inspects bolt-ends, another addresses packages. Constantly the operations are being performed at higher pressure and at greater nervous strain. Constantly the hours are being shortened, leaving more time for recreation. But the question is, how shall the worker find recreation such that he will return to his bench or desk refreshed and content? The famous Taylor of scientific-management reform proved by indubitable tests that more hard work can be accomplished if the workman has suitable rest at short intervals. How much more important is it that proper recreation be available for the time off shift. What recreation then is possible?

In the great industrial districts of Germany the worker from factory or mine takes his family in the evening to a beer-garden, where for the price of a stein or two of beer for each they see and are seen, converse, and are entertained. In France there are the boulevards with their little tables where a few cents spent for wine or beer permits one to sit and watch the world wag by. Baedeker says of urban Frenchmen, "most of them spend their evenings at the cafés, where they take coffee, liqueurs, or beer, meet their friends, read the newspapers, or play billiards or cards". The most popular amusement in the United States, particularly since the coming of prohibition, is the 'movie'. It is popular also in British countries—though sports and the public-house contribute to their entertainment. The darkened and speechless atmosphere of a cinema-theatre seems especially to suit the Anglo-Saxon; perhaps the vicarious methods of adventure agree with his puritanical instincts.

In America the automobile is a coveted means of recreation, but as a national palliative it has serious limitations. Many workers cannot afford it; many do not care for recreation that consists in driving a machine; and, after the novelty has worn off, riding to a destination and then returning loses much of its zest. Possibly when travel in the air has been perfected and cheapened, flying will become the great recreation of civilized man, particularly if small airplanes can be manipulated without too much effort and attention, much as a sea-gull soars and glides above the dust of mundane things.

There remains the recreation of art, by which is meant literature, music, and the fine arts generally. William Morris suggested that the true function of art is to allay restlessness and discontent. Ruskin tried to put the principle into practice by establishing an art-gallery in the slums of London. The idea is excellent in theory, but has not worked well in practice, especially among the American or British peoples. Theodore Roosevelt said flatly that Americans are inartistic, and he was probably right. Who can imagine grand opera, or poetry, or paintings allaying discontent in a factory-town in New Jersey or a mining-camp in Arizona? The result would be something like Carol Kennicott's attempt to brighten up Gopher Prairie!

When all is said and done, the nearest approach to true recreation in America was the much-maligned saloon. It was so seriously abused by 'treating' that few are sorry that it is gone. But it was our nearest approach to the beer-garden of the German or the boulevard café of the French; it was, in a way, the poor man's club—a place where the worker could resort and chat with his fellow without feeling ill at ease or patronized. After all, it is chatting with one's fellows that makes real recreation; exchanging ideas by talking marks human beings apart from other animals. The so-called community-centres and welfare-stations are misguided attempts to replace the saloon; they approach the problem from the wrong angle. It is perhaps difficult to explain why a 'community-centre' does not attract and interest the solid backbone of an industrial centre to the extent that a saloon used to, or to the extent that the beer-garden and café interest the European. There is an atmosphere of artificiality or futility or condescension about such a place that bores the average worker. A meeting-place, to be a real centre of sociability, must be casual yet full of possibilities; it should be a meeting-place indirectly while ostensibly something else, and there should be many of them in a town, so that, if a man doesn't like one, he can try another.

Much of the discontent and labor trouble of the past several years in this country has come from the worker having no proper recreation. He found himself in the hours off duty with nothing to do except grumble and agitate. If the nation can evolve a satisfactory substitute for the saloon, meeting-places where the population

can congregate without self-consciousness or boredom, one of the serious problems of the future will be solved. For it is not too much to say that, of the great industrial nations of today, those which furnish satisfying recreation to their workers are going to surpass those which do not. Certainly man does not live by work alone; he must have relaxation and sociability; and as work becomes sterner and more intense the need of recreation becomes correspondingly greater.

P. B. McDonald.

New York, October 15.

Monetization of Silver

The Editor:

Sir—In a recently published article, Mr. George W. Hinman presents and argues for the London 'Statist' plan of restoring currency, exchanges, and trade. He urges:

"That the depreciated currencies of France, Italy, Germany, Belgium, and England be made convertible into gold at their present dollar value."

This amounts to repudiation to a certain extent of the obligations of these governments, and it is manifestly unfair to establish permanently a reduction in the value of the circulating medium of those peoples because in time their currencies will probably recover their standing. The exchange rate as quoted is an arbitrary rate, changeable from day to day, and based upon speculative ideas as to whether the people can recover and pay, or not.

What I am about to say may not suit the views of many people, but thinking people who have watched the trend of events, since the final repudiation of bi-metallism in the United States, will, I think, at least give the matter careful consideration. It is not a new idea; it has simply remained dormant, but it is time that it should be given expression.

A glance at the exchange rates shows that those of India and China (where silver is the money of the people) are depreciated (in terms of gold), and this depreciation is practically the depreciation in the bullion-value of the silver in the rupee, in India, and the small silver bars used as currency in China. In all the European countries there is a certain amount of silver coin in circulation (much of it, however, at present, buried in the ground for safe-keeping). This as well, under the present laws and conditions, is depreciated (in terms of gold) to its bullion-value.

Silver is the money of more than three-fourths of the people of the earth, and remains as such, notwithstanding the arbitrary establishment of the single gold standard, and the demonetization of silver in the United States, and some few other countries. It is in demand by foreign countries as shown by the recent advance in the price of silver bullion produced outside the United States. Since silver was demonetized by the United States, or during the period 1894 to 1920, statistics show that about 5,000,000,000 fine ounces of silver has been produced in the world, all of which has gone into use; a small proportion has gone into the arts, but by far the greater portion has gone into circulation as money in India, China, Japan, and the other foreign countries, the United States not having been a purchaser except for small amounts.

The principal silver-producing countries are the United States, Canada, and Mexico, while practically all the countries are users of silver as money, while in India and China it constitutes the great bulk of the circulating medium. The restoration of silver to its proper basis as money at the ratio of 16:1 with gold (or at the rate of $1.2929 per ounce), as it existed for many years prior to its arbitrary demonetization, would have the effect of bringing up the exchange-value of the currency of India and China to par, and would practically double the present value of the silver coin circulating in foreign countries, and by restoring it as a money metal would broaden the coin basis, behind the paper currency of those countries, and thus tend, in a measure, to increase the value of the promises to pay of those countries, and assist in stabilizing the various rates of exchange. It cannot be expected to restore entirely the currency of those countries that have issued paper currency far in excess of their ability to pay, but what silver they have, together with the gold they have, or may obtain, would form a nucleus upon which they could establish a limited credit, and give them a sound economic basis upon which to build, and gradually retire their excess paper currency.

The enactment of a Free Coinage Act by the United States on a basis of 16:1, and making it legal tender for all purposes, public and private, would restore it to par all over the world, or if considered preferable, joint action of similar character could doubtless be had between the United States, Canada, and Mexico, with the same effect. The principal objector will probably be England, who has desired, and probably now desires cheap silver to settle her exchanges in England and China, but the beneficial effect upon the exchanges of all countries, including her own, would probably outweigh her objection, and it would probably have a good effect in settling the unrest in India. All other countries would doubtless welcome the opportunity.

The Senators from Nevada, (Jones, Stewart, and New lands), W. J. Bryan, and the leaders in the fight against the demonetization of silver from 1876 to 1893, were correct in their position and claims, and time has proved such to be the case—the opportunity now offers to restore silver to its proper place as a money metal, and at the same time, and by this means, assist these other peoples in their struggle to get on a solid footing.

Gold and silver together were for ages the money of the world. More than one-half of the hard money of the world was depreciated in value when silver was discredited as money by unwise and uneconomic legislation. All forms of paper money are but promises to pay hard money. Restore silver to its proper place, and you double the hard-money basis behind the currency. The only country that benefited by the depreciation of silver was

England (all others, including her colonies, were injured); for by settling her exchanges with India and China with depreciated silver, she could in a measure control and lower the price of the wheat and cotton she required, regardless of the law of supply and demand, and to the detriment of the producers of these staples in other countries.

An International Court, to settle disputes between nations, backed by an international agreement, to enforce its rulings, binding upon the various nations, after ratification by the people of the separate nations, coupled with the adoption of the restoration of silver, and a consequent doubling of the hard money of redemption of the world, would go a long way to prevent future wars, reduce taxation, and restore the people of the world to peace, and to a sound economic basis.

S. A. KNAPP.

San Francisco, October 24.

Wetting and Amalgamation

The Editor:

Sir—An interesting view of the function of oil in flotation has recently been advanced by one of the examiners in the U. S. Patent Office, which prompts me to ask the opinions of your readers on the question. The examiner takes the view that the selective preferance of quicksilver for gold is analagous to the selective preference of oil for metalliferous substances. To me the functions of oil toward metallic particles in an ore are quite different from those of quicksilver toward gold. Amalgam is entirely different from flotation concentrate, or, to make the analogy closer, from the concentrate that collects on greased belts, as in the patents of Haultain, Wolf, and others.

Gold amalgam in an excess of quicksilver is either a true solution as an alloy dissolved in quicksilver, as gold in a true solution, or it is an alloy of variable chemical structure, according to the amount of quicksilver available for the structure. Such a condition would not seem to be parallel with that found in a mechanical mixture of oil and sulphides, or oil and metal particles.

SAMUEL H. DOLBEAR.

New York, October 14.

Metric Weights and Measures

The Editor:

Sir—I note with interest your editorial on the subject of the introduction of a metric system of weights and measures. I have read, also, the papers on the same subject by W. R. Ingalls and Howard Richards Jr. in the May issue of 'Mining & Metallurgy'. I think that your reasoning is excellent and forceful, and I particularly like your suggestion that the matter be considered in the light of future welfare rather than of present inconvenience. The possibility of world uniformity is also most important. Mr. Ingalls, who writes as if he wished to win his case regardless of its merits, tries to settle the matter with the statement that, "considering the Indo-European race alone, there is a much larger part of the population that does not use the metric system than does; and their nations are far superior in industrial development . . ." The accuracy of this statement depends, so far as numbers are concerned, upon the 'Indo' part of the term Indo-European; for it includes against the metric system (in a negative sense) the 314,852,881 people of India who, according to the census of 1911, do not speak English or other European tongue. The 'Statesman's Year Book' for 1920 gives the population of India, according to the 1911 census, as 315,156,396, of whom 303,515 spoke English and 122,919 were British.

All the countries of Europe, except Great Britain, Russia, and that part of Turkey which still remains, use the metric system and make its use obligatory by law. I have been told by Russians that all scientific and industrial work there was done entirely in the metric system in pre-bolshevist days; most of us remember the fights for the 183- and 203-Metre hills outside Port Arthur during the Russo-Japanese war of 1904-1905. Moreover, as stated in the year-book referred to, Poland, Lithuania, Latvia, and Finland have all made the metric system official and obligatory since they separated from Russia after the War. Japan, which for some time has used the metric system in conjunction with its old systems, has this year adopted regulations making the use of the new system obligatory; the change will be gradual.

One of the favorite arguments of those in this country who are against the adoption of the metric system has been that in Mexico and in Latin America generally its use has not been universal, although it was adopted officially many years ago. The idea has been to imply that other measures might have been found to be more convenient. On the contrary, the metric system is the only one that is taught in schools and colleges, and it is used exclusively in all scientific work and in engineering by the natives of those countries, as well as in all official records. The use of any other system at all has been because of the demand of foreign trade with English-speaking people, because of industrial undertakings that are controlled by them, or as the result of the adherence to the relics of antiquated systems from which the uneducated people in remote districts have not yet been weaned. If the English-speaking peoples did not form so important a part of the foreign trade of those countries, measures other than metric would soon disappear, as they have over all those parts of Europe where the metric system has been long established.

The population of the European countries that use the metric system entirely (excluding Russia) totals about 300,000,000. The Latin-Americans who use it, except when they are obliged to do otherwise to please foreign clients, number about 85,000,000; the Japanese, 60,000,000. On the other side of the slate we have a total of 65,000,000 Britons (including those in all British colonies but excluding subjugated populations of alien race), and 105,000,000 Americans, who use variants of the English system or systems; so that a total of 450,000,000 civilized

people use the metric system against 175,000,000 who use the English system. It is not a fair comparison, however, to count the number of people that use one system against those that use the other; for in the one case the system used is the relic of primitive and unscientifically developed units, for the continuance of which there is no apparent reason except that they have been handed down from generation to generation; we have learnt them, or have tried to, in our childhood. In the other case there has been a deliberate adoption of a scientific method, by peoples to whom it was at first strange, and who had to discard the antiquated systems in former use that were similar to, and, in general, as good as the English one.

The 22 separate nations of Europe, together with the 19 of Latin-America and Japan who have adopted the metric system, presumably have done so because they considered it superior; its adoption was worth more than the inconvenience that would result in making the change. In the case of Latin-America, I confess that the adoption of the system may have been due, in part, to an admiration of, and willingness to follow, French lines of thought. However, this cannot be given as the reason in such cases as Germany, Holland, the Scandinavian countries, or Japan. No self-governing people has ever changed from the metric system to any other, nor is there any reason to suppose that one ever will. It will therefore seem that the hope of securing world-wide uniformity rests on the adoption, by all, of the system that progressive nations have adopted—nations who wished to improve on antiquated and unscientific methods. Moreover, the metric system is so generally used already that if the United States were to make its adoption legally compulsory it seems unlikely that the British would allow much time to pass before they followed suit; world-wide uniformity among civilized peoples would then be an accomplished fact.

There is no need to enlarge on the matter of the greater convenience of the metric system, but it is pertinent to remark that, to the engineer, it is not merely its decimal arrangement that is attractive, but the almost ideal interrelationship of units of length, volume, weight, and power, which require little effort to keep in mind, and little or no calculation or the use of tables to apply. If the law were passed, making the metric system the only legal one, that alone would effect the change. Farmers might continue to think in bushels until they found it more convenient to think in the hectolitres in which they would sell and ship; storekeepers might sell merchandise by the foot, so long as it was billed in metres. Moreover, the dimensions of articles would not have to be changed, except in so far as the manufacturers wished to change them; they would merely be given in other terms. I can see no necessity for any direct expense except for paper, printing-ink, and clerical work. The individual would have to become accustomed to think in the new units, and many to whom the metric system is new are frightened at the prospect; but we have heard little about the difficulty, if any, experienced by others who have made the change; and surely we would have done so, had it amounted to anything.

I am not sanguine about the early adoption of the metric system in the United States, whatever its merits; there seems to be a strong prejudice among those of British race against any change in things they are accustomed to; this is shown by the rioting that took place in London in 1752, when the Government deleted 11 days from September, in order to correct the obvious errors in the old Gregorian calendar. This country is not being run as it was in 1787, and I hazard the guess that, if the decimal system of currency had not been adopted then, Mr. Ingalls and his supporters would be arguing as to the superiority of a system of pounds, shillings, and pence, as some still do in England. Incidentally, I consider that the advantages of a decimal system of currency are not nearly so great over the sterling divisions as are those of the metric system over the non-related systems of length, area, volume, and weight. I do believe, however, that sooner or later the change will have to be made—that some day our merchants and manufacturers will understand that it is to their ultimate advantage to adopt a time-saving system and to conform to the units used by the majority of civilized people. Obviously, the sooner the change is made, the easier it will be to make it.

HUNTINGTON ADAMS.

New York, October 19.

Time Element in Cyanidation

The Editor:

Sir—In your editorial in the issue of July 2 you omitted to give, among common sources of error in testing ore for cyaniding, the element of time. That is most important, particularly where silver is concerned. About 20 years ago, when the cyaniding of silver ore was little understood, I built a mill to treat an ore averaging 13 oz. silver and 3 dwt. gold per ton. Over a year was spent in experiments, and, to make sure, a five-stamp mill was hired, and vats were built to treat the ore in two-ton lots, exactly as it would be treated in the mill. Results showed good extraction from sand and slime, so the big mill was erected with confidence.

To our surprise, although the slime gave a good extraction, we failed to get the silver out of the sand. Of course we invented all sorts of explanations, and it was some time before we found that we had overlooked the time factor, and that the ore required about four times as long to treat as we had allowed for. Our experimental work was right, but we forgot that, in the small mill, we did not work continuously, but only on the day-shift, and we left off from noon on Saturdays to Monday mornings. During the time we were resting the ore was soaking, and altogether it had the long time necessary to give a complete extraction; so we had to enlarge the vats.

EDGAR HALL.

Silver Spur, Queensland, September 20.

THE CALIFORNIA RAND SILVER MINE, LOOKING TOWARD RANDSBURG

The California Rand Silver Mine—I

The Story of the Enterprise

By Arthur B. Parsons

The story of the California Rand mine invites, and indeed deserves, less prosaic treatment than it necessarily must receive in this article. An interesting chapter on the subject might be entitled 'From grubstake to affluence in 90 days'; another might be 'Miss Edith Coons: a prospector at heart'; a philosopher would be tempted to discuss the 'Psychology of Prosperity' if he were to visit Randsburg today; and an excellent sermon for the present-day prospector might have as its text 'The California Rand mine; a bonanza that lay undeveloped for 25 years, within a hundred feet of a good road in the heart of a well-known mining district'. However, I shall endeavor to relate the story briefly, starting with the first discovery in the Randsburg district in 1893.

The accompanying map of California shows that the Randsburg district is situated almost on the dividing line between Kern and San Bernardino counties. Railroad communication is by way of Mojave, a station on both the Santa Fe and the Southern Pacific railroads; Bakersfield is the nearest city of importance, and all the large stockholders of the company owning the California Rand mine are residents either of Bakersfield or of Randsburg. Incidentally, I may remark that, up to September 1, 1921, they had received almost exactly $1,000,000 in dividends, the first distribution having been made on September 10, 1919, just five months from the day the original discoverers chanced to pick up on the hillside a piece of loose rock that one of them recognized as being hornsilver. In a little more than two years there has been shipped 22,000 tons of ore that netted, after payment of high freight and smelter charges, $1,729,170.80. The gross value of the silver and gold in the ore averaged more than $100 per ton.

The year 1893 was particularly dry, so that farming in the valley above Mojave languished, a circumstance that stimulated prospecting for placer gold in the hills, where a number of productive claims were worked. These included the Goler, Summit, Red Rock, El Paso, Last Chance, and Black Mountain, all of which proved profitable to their owners. One of the partnerships that was created for the purpose of mining gold consisted of Frederick M. Moores, formerly of the 'Brooklyn Eagle'; Charles A. Burcham, a teamster; and John Singleton, a hard-rock miner; they traced the alluvial gold to its source on Olympus mountain, where they staked 11 lode claims and organized the Rand Mining Co., the name being changed a little later to the Yellow Aster. The total production from the Yellow Aster has been $9,000,000 in gold, and in late years it has paid dividends to the amount of $1,250,000. Following the discovery made by Moores and his partners, hundreds of claims were staked and the town of Randsburg grew at the foot of Olympus mountain. There seemed to be plenty of gold near the surface, and the town prospered. In 1894 the Garlock stamp and amalgamation mill was

built at a point 12 miles below Randsburg; later a mill was built at Barstow on the main line of the Santa Fe railroad. Both these plants received high-grade gold ore from the Yellow Aster and from other mines; much of the ore returned $600 to $1000 per ton by straight amalgamation.

Tradition has it that outside capital was not welcomed; the reason for this attitude of exclusion is explained by the following incident, the accuracy of which is readily vouched for by 'old-timers' at Randsburg. It seems that George Kinyon and his two sons, Will and John, owned the Good Hope group of claims, from which they were mining rich ore as rapidly as they needed money. A group of capitalists at Los Angeles was desirous of doing some speculating in gold mining, and, without any extensive preliminaries, began negotiation for the Good Hope claim. But Messrs. Kinyon declined to show any particular interest. Someone suggested privately to the representatives of the capitalists that the Kinyons distrusted banks and paper money, whereupon a wire was sent from Los Angeles saying: "Am placing $150,000 gold coin in Wells Fargo office subject your order for Good Hope mine". In behalf of his sons and himself, the elder Kinyon, although he had full confidence in the Wells Fargo Express company, declined the offer on the ground that after the education of the children and the comfort of the womenfolk had been provided for, there would be only about $30,000 apiece for the father and two sons. "This", he said, "is so little that if we should accept it there would be a foot-race to see who could go broke first so as to borrow from the others." When one visits Randsburg he will probably be told this story by way of explanation of the lack of deeper development of the mines.

In 1895 the Yellow Aster company erected a 30-stamp mill, and in 1900, when the railroad was extended to Johannesburg, two miles distant, a 100-stamp mill was built. To supply this plant the mine was opened as a huge glory-hole and a large volume of low-grade ore was milled. The rising cost of labor and supplies, however, caused the suspension of operations in 1916, although I am told that part of the mill has been in regular operation on ore mined by sundry lessees since my visit to Randsburg last August. It is interesting to note that Dr. Rose L. Burcham, the widow of Charles A. Burcham, is now secretary for, and a prominent stockholder in, the Yellow Aster company. This fact tends to support the statement regarding the inhospitality to outside capital.

When beginning this story, I suggested a discussion of the psychology of prosperity. Prosperity is contagious; it breeds optimism. Most of the inhabitants of Randsburg are either miners who are earning excellent wages in the California Rand Silver mine and at neighboring prospects or they are owners of old mines or leases in either the gold or silver 'zones' of the district. Those in the first class are prosperous; those in the second are optimistic. The rich silver ore that is being mined from an orebody two miles distant can have little significant geological relation to the gold-bearing veins, but it has had the effect of renewing the confidence of these faithful old adherents to a 'camp' that has been almost dead, so far as gold mining is concerned, for several years. They point to the millions produced from shallow workings in the past; they point to the fact that, except for the Yellow Aster company, nearly every man did his own mining, spent his money as fast as he got it, and accordingly didn't have the capital to follow the lode when it faulted or when the grade of the ore diminished. They point rhetorically to Butte, to Virginia City, to Leadville, and they declare that Randsburg's only need is outside capital to develop 'at depth' the mines that are already opened. Then, they say, will follow a resurrection that will make the present prosperity seem like the

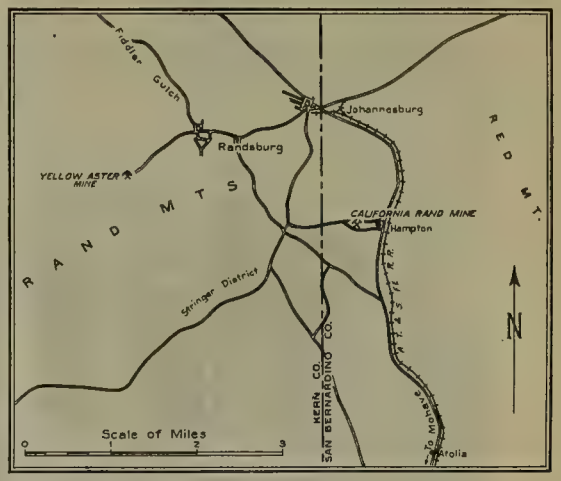
flurry before a storm! These old-timers are pleasant to talk with; their hope is the fond hope of every miner; and, as I say, their faith is bolstered by the prosperity of their neighbors who are mining silver. No one can help but wish that their dreams may be realized.

During 1916, 1917, and 1918 the Atolia mine, five miles to the south-east, was in active operation, and Randsburg enjoyed some of the fruits of a payroll that amounted to about $60,000 per month. The Atolia during this brief period produced nearly $10,000,000 worth of tungsten ore. However, in the spring of 1919, when the demand for tungsten ceased, the town was very quiet; the only activity was some desultory development work and prospecting for gold. Among those who persisted in digging were the owners of the K C N lode claim, over which passed the highway from Randsburg to Atolia and thence to Mojave. To many, K C N suggests the cyanide process of extracting gold; but the locators

of this claim were more intent upon mining ore than on treating it. K stood for Kelly, C for Coons, and N for Nosser, which introduces three of the principal characters in the present story. John W. Kelly had mined at Randsburg years before, after which he had gone to Bakersfield, where he had served as Sheriff of Kern county for several terms. Miss Edith F. Coons was County Assessor for Kern county, having succeeded J. M. Jameson, for whom she previously had been deputy; and Jack Nosser was a typical miner who boasted no particular accomplishment other than the ability to sink a hole into hard rock under adverse circumstances. He was the type of miner that the 'movie' directors try to imitate—I say "was" because outwardly, at least, he no longer 'is'. The fourth partner was W. H. Williams, familiarly and generally known as 'Hamp'. His mother was a Piute Indian and his father was a prospector of considerable intelligence. From them probably he has inherited his instinct for living in the hills and searching for mineral. He had studied enough to know something of the character and the habits of ore-bearing rock. Some years before, he had discovered the Cowboy and the Gold Peak mines in the Amelia district near Bakersfield, but in 1919, like Nosser, he was financially 'broke'.

Accordingly, these two did the work on the K C N claim while Kelly and Miss Coons supplied the money to buy powder, tools, and 'grub'. In the course of a conversation with me during my recent visit to Randsburg, Hamp said a number of interesting things; among them was this: "Miss Coons was a good gambler all right". This, I believe, is as genuine a compliment as was ever given one prospector by another—for Miss Coons is truly a prospector, even though she did not share in the actual work of searching for ore. For a long time she sent Nosser and Williams $75 per month from her none too generous earnings, which she might have spent for more tangible things; that the 'investment' made her wealthy is to the credit of Dame Fortune, but to Miss Coons must be accorded the honor of having the nerve to play the game. Every one with whom I talked has a high opinion of Miss Coons.

The K C N shaft reached the depth of 100 ft. without revealing shipping ore, although some good stringers were cut. Williams and Nosser were feeling rather blue, when Kelly received a letter from Los Angeles inquiring about possible deposits of hematite suitable for making paint. He persuaded Hamp and Jack to go across the valley east of the K C N ground and stake some claims that he thought might contain hematite. This they did on the 12th day of April 1919. According to Hamp, Nosser started ahead of him on the return journey to the camp at the K C N. Williams, following, found Nosser sitting near a pile of loose rock on the side of the hill about half a mile from the K C N claim and only 30 ft. from a well-traveled road. The rock near where Nosser sat had apparently been blasted loose from the lode by some prospector; Jack was idly looking at a piece when Williams came up. "That's funny looking stuff, Hamp; I wonder if it's any good?" inquired Nosser as he handed it over. Nosser's mineralogical examination had concluded with a fruitless search with his lens for free gold; Hamp was more sophisticated—he knew hornsilver when he saw it! He wisely declines to express an opinion as to the exact phraseology of his pronouncement; even seasoned prospectors do not stumble on a fortune in the middle of a desert and retain their composure, so it is reasonable to suspect that there was some picturesque language wasted in the vicinity of Randsburg along about sundown of April 12, 1919. The upshot was the taking of two samples, one from the part of the 15-ft. outcrop that looked best, and the other from the entire 15 ft. The assay-returns from Los Angeles showed 280 and 360 oz. of silver per ton, though strangely



RANDSBURG AND VICINITY

enough the richer sample was the one the men thought came from the entire 15 feet.

In addition to the silver, each sample contained about three ounces of gold per ton. Here I venture to address a few words of admonition, and more particularly of encouragement, to the prospector. Probably 100 men had noticed this outcrop and had examined the rock; many of them had even gone so far as to break up some of it for testing in their pan. But the gold is not free; it will not 'string' a pan, although a ton of the ore contains several ounces of it. The moral is that a prospector must educate himself in the elementary principles of mineralogy; otherwise his work cannot be efficient. The detection of gold that is combined to form other minerals may be difficult, but at least the prospector should familiarize himself with a few dozen common minerals such as hornsilver, as Hamp Williams had done. Looked at from a different angle, these same circumstances hold much encouragement for the prospector. For years this remarkable deposit lay undiscovered, although it was in the path of scores of men whose lives were spent in searching for likely-looking outcrops. The complaint is sometimes made that all the good lodes have been discovered, or that most of those remaining do not appear

on the surface and must be found by costly exploration with diamond-drills, churn-drills, or other expensive machinery. The California Rand mine belies this conclusion; the narrative of its discovery should put new heart in our friend the prospector. There are thousands of square miles of California, Nevada, Arizona, Utah, and other Western States that offer the most attractive possibilities of rewarding his efforts. It is safe to say that there are hundreds of orebodies just as good as that of the California Rand—rich as it is; all that is necessary is to find them. Prospector, take heart! Equip yourself properly with the paraphernalia for making tests, with a reasonable knowledge of minerals, and with the persevering spirit without which no prospector ever succeeded, and go out in the hills. If your courage flags, there will be more hereafter, but all his transactions with the company seem to be marked by a spirit of square dealing. He sampled the outcrop carefully; the returns from his samples verified the former results, and the probability of opening a bonanza was established.

Investigation revealed the fact that the discovery was made on the Juanita claim (shown on the accompanying map), and that this claim was still valid by virtue of the performance of the annual assessment work. The other claims in the vicinity had lapsed. A man named McCormick, of Los Angeles, had located the claim and had sunk a shaft 130 ft. deep and driven a 75-ft. adit in a fruitless search for gold ore. The shots that had exposed the rock where Hamp and Jack found it were doubtless put in by McCormick's men when they were prospecting.

J. J. Nosser J. M. Jameson
W. Hamp Williams J. W. Kelly

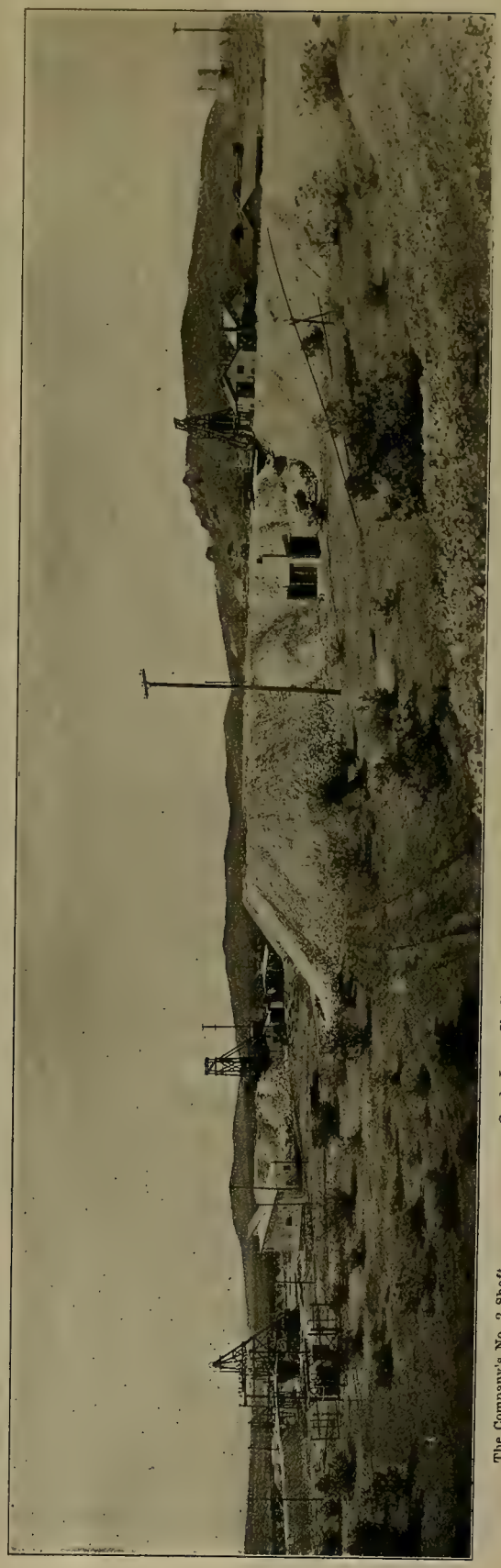
THE FIRST LOT OF HIGH-GRADE ORE, A FEW OF THE OWNERS, AND SUNDRY VISITORS

think of Hamp Williams and Jack Nosser and the California Rand, or, for that matter, of a hundred others whom fortune favored before them—and since.

Kelly was a cautious individual; he wanted to be sure. Accordingly he wrote to Jameson at Bakersfield to come out and bring Edward T. Grady with him. During the later period of the development of the K C N, Miss Coons had been pressed for money, and Jameson had agreed to advance $1000 for her. Accordingly it was agreed that Jameson should have half of the quarter interest held by Miss Coons by virtue of her grubstake agreement. Grady was a man of considerable experience in mining and they all had implicit confidence in him. I am told that if he had been so inclined, Grady, with his superior knowledge of business, could have obtained a large share of the mine for himself; that he did not, indicates that the confidence of the others was well founded. He is now making a fortune for himself and his partner from the Grady lease, concerning which Like hundreds of others who had passed over the outcrop, they were seeking gold, not silver, and they accordingly overlooked the huge deposit of hornsilver. Kelly was delegated to go to Los Angeles, where he obtained from the son of McCormick, who had died in the meantime, a bond and option to buy for $5000. In the meantime the Uranium group of claims was staked, thereby effectively covering what then appeared to be the valuable ground.

As I have related, Williams and Nosser were without money; had they known how far the rich ore would continue below the surface and how wide the vein would be, they would have needed none except what was required to buy their grub while they dug out a few carloads themselves. When work was started a huge block of ore 22 ft. by 18 ft. in horizontal section and 70 ft. deep was mined, beginning at the surface; and every pound from this pit was shipped to the smelter. Until dividends amounting to $96,000 had been declared, the mine was

Looking Down the Valley Toward Atolia



The Company's No. 2 Shaft Grady Lease Shaft The Company's No. 1 Shaft

TWO VIEWS OF THE CALIFORNIA RAND SILVER MINE

literally without a dump. However, this could not be foreseen, and accordingly Williams and Nosser each sold half of his quarter interest for $1000. Alfred Harrell, editor and proprietor of the 'Bakersfield Californian', took an eighth interest, and a group of eight men, including Grady, divided the other eighth equally. Harrell is now president of the company and the leading figure in the administration of affairs; he has been highly successful in directing the general policy of management.

An episode connected with the exercising of the bond and option is interesting for the reason that it involves a nice point of law. Mining claims in California are not community property between husband and wife; however, if both husband and wife contribute funds for the performance of assessment work, it seems that an unpatented claim becomes a community interest. Kelly had neglected to get the signature of Mrs. McCormick on the option, which was being held in escrow in a Los Angeles bank. The terms of the bond provided that McCormick should receive a small proportion of all smelter returns until the $5000 had been paid. He accepted the checks sent him as his share of the proceeds from the first two shipments, but the third draft remained uncalled for in a Los Angeles bank. When two weeks had elapsed and the remittance was still unclaimed, Mr. Harrell at Bakersfield quite naturally became alarmed, particularly in view of the fact that McCormick was a lawyer and would no doubt be aware of his technical rights; obviously, it would not be difficult to establish the fact of Mrs. McCormick's participation in financing the performance of assessment work. Harrell endeavored to get into communication with McCormick by long-distance phone, but the latter apparently did not care to discuss the matter by phone and failed to respond to the call. Thereupon Harrell wired to Jameson, Kelly, and Miss Coons, at Randsburg, directing them to meet him at Mojave that night. In company with Dwight L. Clarke and C. V. Anderson, respectively secretary and attorney for the company, Harrell drove to Mojave and the whole party, comprising the owners of the majority of the shares in the company, made a night ride by automobile to Los Angeles, reaching their destination at daybreak.

The 'board of strategy' held a conference on arrival at Los Angeles. It was finally agreed that, if necessary, as much as $50,000 would be paid to settle immediately with McCormick rather than involve the mine in litigation.

Kelly, who had done the original negotiating, volunteered to interview McCormick. His first move was to tender the unpaid portion of the $5000 with the explanation that his associates, in order to facilitate other financial arrangements, desired to fulfill the terms of the option at once. He then simulated great astonishment when he was informed of the irregularity in the signing of the bond. During the ensuing discussion, intimation on the part of Kelly that his associates might consider the payment of $10,000, to avoid any controversy, failed to arouse any outward enthusiasm in McCormick; Kelly withdrew, ostensibly to communicate the surprising revelation to his associates.

The next move in the negotiations, which had some of the elements of an interesting poker game, was a second visit to McCormick's office, this time by Harrell, Jameson, Kelly, and Anderson, together. Harrell, who acted as spokesman, relates the story of the interview in these words. "'After some preliminary sparring, I put the bald query: 'Well now, Mr. McCormick, how much do you want, spot cash, to sign a deed according to the option given to Kelly?' 'I ought to have $15,000', was the reply. 'Bring the deed, signed by yourself and wife, downstairs to the bank', I said; and in fifteen minutes the transaction was complete. An hour later we started on another night ride back to Randsburg, but with a heavy burden lifted from our minds.'" Riding at night on the desert is exhilarating under any circumstances; added to this was the satisfaction of having cleared their title to the property that they confidently believed would become California's greatest silver mine, and of having 'saved', incidentally, $35,000 in cash. The serenity of the travelers on the return journey to Randsburg doubtless contrasted sharply with their feelings of the previous night when they didn't know whether they owned a mine or not.

Sundry transactions in the stock, which incidentally has never been offered on the open market, are of interest. When the 'pit' was 20 ft. deep, Ben Sill, an oil-operator of Bakersfield, paid $50,000 for an eighth interest, 1/64 of which came from Miss Coons and 3/64 from Kelly. This sale was negotiated by Grady, who also, a little later, sold an eighth interest to a syndicate of Bakersfield men, one-sixteenth coming from Nosser and the same from Williams. The consideration was $105,000, or on a basis of $840,000 for the entire mine, which at that time consisted of a pit-like shaft only 90 ft. deep. That the judgment of the purchasers, or perhaps I should say their luck, was not bad is indicated by the dividends that the company has paid already.

Next comes the story of the Grady lease. In the accompanying photograph there can be seen on the hill to the left a bold outcrop that stands out like a 'dike'. This silicious dike can be traced in a northerly direction along the hillside, where it outcrops about 125 ft. west of the discovery shaft. Surficial indications all pointed to some definite relation between this dike and the ore deposit, and accordingly claims were staked with their side-lines approximately parallel with the strike of the outcrop. Numerous geologists and engineers who visited the district were frank in expressing the opinion that the orebodies should be adjacent to this dike, or that they should be found in near-by veins or fracture-zones parallel with it. In order to hasten prospecting of its ground the company encouraged lessees to develop small blocks. The accepted theory that the trend of the dike gave the key to the disposition of the orebodies guided these lessees in the selection of their ground, with the single exception of Grady, who chose for himself and his partner, Ben Sill, a block adjoining the Uranium No. 2 claim

on the south-west. This was in the area known as the 'flat', and the selection was ridiculed by everyone who pretended to be able to fathom the mysteries of local geology. However, Grady started sinking; and he continued to sink persistently through barren schist for 260 ft. At this point the shaft entered high-grade ore in a deposit that appeared to be of considerable size.

The terms of all the leases, including Grady's, were

CLAIM-MAP OF THE RANDSBURG DISTRICT

peculiar in that they contained an 'apex' clause. Ordinarily a lease of this character defines certain limiting planes and provides that the lessee may mine whatever ore he is able to find within the included block of ground, irrespective of the strike, dip, or other structural features of the lode or lodes. It is customary to place a comparatively short time-limit upon the operations of the lessee, thereby preventing him from profiting too greatly in the event that he finds large orebodies. However, in the California Rand leases the following provision, quoted verbatim, is made: "together with the right to said lessee to mine said strip for all lodes apexing *wholly* upon said premises, together with the dips, spurs, and angles of such lodes; but to be confined in the working of the same to the boundaries of the end-lines of said leased premises as same are established and shown on the plat attached hereto and made part hereof, and it is distinctly understood and agreed that the said lessee shall not be entitled to work any vein or lode which apexes wholly or *in part* off of said premises, where any such lode shall dip under or pass beyond said leased premises". The italics are mine.

Construed literally, this provision, I am inclined to believe, would leave the lessee little inducement to work at all; there would be small chance of any vein "apexing wholly within the said premises", which consisted of a block only a few hundred feet in lateral dimensions, and the lessee apparently would be deprived of the right to do any mining whatsoever. The intent, I am told, was to convey during the period of the lease, mining rights similar to those of an original claim-holder. If a segment of the apex of a lode on its strike lay within the

vertical planes of the leased block, that segment or portion of the lode lying between the planes through the endlines could be mined on its dip. Extra-lateral rights were to be recognized. Apparently the lawyer who drew the indenture was familiar neither with physical conditions as they exist in the ground nor with the pitfalls of legal phraseology appertaining to 'apex' geology.

However, when it became evident that Grady had found ore, the company officials brought out a copy of the lease and raised the question of apex. No one could tell just where the lode that Grady had found really outcropped, or whether it outcropped at all. Its apex might be underground; it might be within the limits of Grady's lease; or it might not be. The geology of the district presents numerous interesting features, which I shall point out in a later article.

Grady's partner, Sill, was a large stockholder in the California Rand company, and he was anxious to avoid a quarrel. Grady, likewise, saw the disadvantages of a legal fight, and therefore proposed that the company purchase all the rights of the lessees for $21,000. Sill agreed that, if the directors declined to compromise on this basis, he would support Grady, who was convinced that the lessee had a fair chance to prevail in the courts if a law-suit was to ensue.

The company had only the original inclined shaft and it would certainly need another unless the orebodies 'played out'; Grady had spent some $15,000 for equipment and for sinking, and he had opened some rich ore, although neither the extent of the shoot nor the size and trend of the lode had been determined. These were obvious considerations that favored making the purchase, which moreover would prevent any possible dispute in the event that a large orebody was opened. Nevertheless, the officials of the company, largely influenced by the advice of Jameson, who had become general manager, declined to make the purchase for $21,000. That the decision cost them a million dollars or more has been revealed by subsequent events; but whether the decision was a blunder in light of the conditions at the time, is a question that cannot be answered. If it was, Jameson had the consolation of knowing that many another million had been lost by errors of judgment with regard to mining property.

As soon as the offer was refused Grady started in earnest to open his ore. Within eight weeks he had done enough development work to show that at least a quarter of a million dollars was assured; the shoot in one place was 28 ft. thick and the ore averaged more than $100 per ton, with silver calculated at $1 per ounce. On its apparent strike the lode had been opened for 100 ft. and the drifts were still in ore. The lessees' shaft was but 300 ft. from the company's shaft, and the 600-ft. by 300-ft. block lay with its long dimension along the side-line of Uranium No. 2 in the general direction of the strike of the ore. It appeared to be likely that a goodly proportion of the orebodies lay beneath the surface enclosed by Grady's lines. Both Grady and the officials of the company realized this; but both sides were keenly aware of the undesirability of going to court to settle the question of ownership of the ore under the apex clause of the lease.

With a display of practical common sense that does credit to all concerned, and with a spirit of tolerance and willingness to compromise that is only too rare, they put their heads together to find the best way out of the difficulty. From various sources I gather that they were influenced to a large extent by this idea: "There is plenty of silver here to make us all rich if we go ahead and mine it and sell it as rapidly as possible; if we quarrel, the production of ore will be delayed, our organization will be demoralized, and the experts and lawyers will get most of the money. Let's settle the matter once and for all and then bend all our energy toward producing silver while the Pittman Act assures us a good market". If Messrs. Harrell, Grady, Sill, Jameson, and the rest had stopped to analyze their motives I believe they would have discovered some such train of thought, although I suspect that, if the facts since revealed regarding the lodes and orebodies, had been known at the time, the terms of the compromise would have been somewhat less favorable to Grady and Sill. At any rate, the outcome was a settlement by mutual agreement reached within a short time. Grady and Sill agreed to decrease the size of their block to 120 ft. square in lateral dimensions, thereby giving them 60 ft. instead of 300 ft. in each direction along the strike of the lode, and diminishing by more than half the distance in the direction of the dip. A horizontal plane passing through the 450-ft. level of the Grady shaft was also agreed upon as the lower limit of the block. On the other hand Grady was given an extension of six months, or until January 27, 1922, during which to extract his ore. By the terms of the settlement all questions of apex were dropped, the lessees being governed only by the boundaries of the ground. Even though the lessees may have gotten the best of the deal the settlement illustrates the virtues of negotiation and compromise in averting 'war'. Of course, it required cool heads and a lot of common sense.

I may add that plain common sense has been the biggest asset of the men who have been in charge of the California Rand mine. Until recently there has been no one connected with the management of the property in an executive capacity who pretended to be a mining engineer. Jack Nosser was in charge of actual mining at the start and John W. Kelly looked after business affairs for a short time. However, the man who early assumed the management and who guided the destinies of the company until his death in June 1921, was J. M. Jameson. Jameson knew little or nothing about running a mine when he undertook the job, but apparently he had some sound ideas of business and these he applied to the operation of the mine. One engineer who had examined the mine remarked to me that he was astonished that so few mistakes were made, and that the shipments of ore had been maintained with such regularity. Although the orebodies are undoubtedly large and rich, the veins split and pinch, and it is no easy matter to maintain regular shipments of high-grade ore.

A notable feature is the modest character of the surface equipment and buildings; some managers would have spent an additional $100,000 on unnecessarily elaborate buildings. It is false economy to get along with inefficient equipment when better can be afforded; but a handsome office-building or a steel structure to house the hoist are 'trimmings' that can wait for an advantageous time, without interfering with the production of ore. Frequently, an important function of elaborate surface plants is to afford material for impressive illustrations in prospectuses and otherwise to assist in promoting the sale of treasury stock to the esteemed public; this has never been necessary at the California Rand property. A small group of the stockholders felt that Jameson's policies were not sufficiently progressive. However, during the period of his management, No. 2 vertical shaft was started and sunk 150 ft., and tests were made by seven different metallurgical engineering firms with a view to determining the most desirable treatment for the low-grade ore.

Jameson died in June 1921. He was succeeded as general manager by C. S. Meroney who, first as accountant and later as superintendent, had been his right-hand man. I believe that Mr. Meroney is endowed, among other virtues, with a 'nose for ore'; to him more than anyone else is due the credit for directing the development work and the stoping in such manner that it was possible to maintain shipments regularly.

In June of this year, M. N. Colman was engaged as mill superintendent. He has correlated the results of the metallurgical tests made by the various firms and has designed a 100-ton flotation plant, which is now being erected. The tests of the ore and the design of the plant are interesting; they will be described in the third article of this series. J. M. Fox has recently assumed the position of mine-superintendent; with these two competent and experienced engineers to direct the technical work, under Mr. Meroney, efficient and economical operation seems assured. A valued member of the operating staff is T. D. Walsh, who became mine engineer a few months ago in succession to V. A. Gillis, whose connection with the company was brief. Mention should be made of the valuable advisory work of Morris B. Parker who, in the capacity of consulting geologist during part of 1920 and 1921, assisted in the solution of some of the geological problems and made several estimates of the ore reserves.

The main shaft is inclined at an angle of 15° from vertical; it was 730 ft. deep on August 15. Levels have been established at intervals of from 40 to 70 ft.; eleven of them having been opened to date. The total amount of development work is approximately 12,000 ft., exclusive of that done in the Grady lease. Ore has been mined from all the levels except the eleventh, on which the crosscut has only recently cut the vein. The new vertical shaft is 350 ft. from the original shaft in the direction of its inclination. Sinking has reached the 230-ft. point, the plan being to continue, without interruption, to the 1000-ft. level. The site of the mill was selected so as to permit the economical handling of the ore directly from the skip-bins to the crushers. The estimate of the reserves of mill-ore is necessarily indefinite for the reason that little of it has been actually exposed, but a conservative figure is 100,000 tons of ore averaging $20 per ton, with silver selling at $1 per ounce. Manifestly it has been good policy to concentrate effort on the mining of high-grade shipping ore rather than to develop milling ore.

Grady and Sill, from their lease, have been shipping approximately 60 tons of high-grade ore per day for several months. The resulting royalties net the company from $10,000 to $15,000 per month. The lease has until January 27 to run and Grady estimates that he and his associates will make a clear profit of more than a million dollars as a result of their operations.

Adjoining Uranium No. 5 is the Coyote claim owned by the Randsburg Silver Mining Co., in which John W. Kelly and Ernest Blanck are the dominating figures. Both of them are interested financially in the California Rand Silver, and Blanck is a director of the company. A shaft has been sunk on the Coyote claim approximately in line with the original California Rand inclined shaft and the Grady lease shaft. Recently a vein of shipping ore has been opened on the 500-ft. level from this shaft. This discovery has stimulated others who have been working in the vicinity. Bisbee and Bray, lessees who have sunk a 400-ft. shaft on the Osdick group of claims, which lies south from the Coyote, are employing 20 miners and are hastening work in the expectation of finding ore; and Elkins & Flynn are actively prospecting, by means of a diamond-drill, the Silver Reef claim, adjoining the Coyote on the east. In addition, there are a number of smaller operations being carried on principally by lessees, who hope to 'strike' high-grade near the surface.

Including those employed in the gold mines in the western portion of the district, there are probably 200 men in Randsburg at work, earning from $6 to $8 per day; miners are paid $6 to $6.50, depending upon the nature of their work. This is, I believe, the highest wage-scale prevailing in the United States. The California Rand company has made no reduction in wages since the peak was reached during the War. The policy of the company has been to share prosperity with its employees.

There is one manifest result of high wages; general prosperity! The sight of Randsburg is a tonic for the depressed. It is unfortunate that there is no way to give it general distribution—in bottles, perhaps; it might hasten the return to normality. With the exception of the men who live in quarters supplied by the company at the mine, I failed, during a two-day stay at the mine, to see anyone coming to work on foot. I venture to say that there are more automobiles per capita in Randsburg than in any other community in the United States; and that ratio is a pretty good index to prosperity. Everybody in the small world that centres at Randsburg is hard at work; everybody has money; everybody is optimistic. How different things would be if Hamp Williams had not known hornsilver when he saw it!

(To be Continued)

Mining in Russia

Negotiations of the Russo-Asiatic Corporation with the Soviet Government

We give herewith a letter addressed by Mr. Leslie Urquhart, chairman, of the Russo-Asiatic Corporation, to the shareholders of that British company; to his letter we add the one that he sent to Mr. Leonid B. Krassin, the trade representative of the Soviet government in London, explaining why the company found it impossible to accept the conditions under which a resumption of work at the company's properties in Siberia was to be permitted by the authorities at Moscow.

London, October 12, 1921.

To the Shareholders

I am requested by my colleagues on the Board of Directors to send you herewith copy of a letter to Mr. Krassin in regard to the negotiations with the Soviet authorities.

The negotiations, which had been inaugurated some five months ago, have been lengthy, mainly because of the large principles involved, but before leaving for Moscow I was able to inform the shareholders that the Moscow government had telegraphically agreed to the basis of the proposed agreement discussed with Mr. Krassin—the return of our properties and working capital in the form of a concession. There were, however, certain outstanding questions on which we were not in complete accord but which we had reason to believe would be settled to our satisfaction.

As a result of these negotiations I was invited by the Soviet government to Moscow for the purpose of agreeing the final terms of the proposed contract for the return of our properties. I therefore left for Russia on August 14, arriving in Moscow on the 20th of that month, and from that date up to the evening of my departure on September 12 I was continuously engaged with the Technical Economic Commission appointed by the Soviet government for the above purpose.

The Commission was a large one including men with business experience in important affairs, some as proprietors or technical managers of large enterprises, engineers, or lawyers in the old days. The direction and decision, however, as to the different clauses of the contract belonged to three High Commissioners—ministers of the Soviet government—who in turn had to submit the draft contract to the final decision of the Council of People's Commissaries under the presidency of M. Lenin. Representatives of different departments of the Government attended the meetings of the commission when called in order to advise on special points or defend the interests of the departments concerned.

As a result of these negotiations a draft concession agreement embodying 27 clauses was prepared and discussed. The intention of this agreement was to return to us our properties in the state they were at the time of nationalization, together with the stocks of materials, working capital, etc. Eighteen of these clauses were agreed by me with the Concessions Committee in Moscow, and in other clauses but slight disagreement existed. It will be seen, however, from the enclosed letter to Mr. Krassin that there are vital questions at issue which made the conclusion of such a contract with the Soviet authorities inadvisable and, indeed, impossible.

Under such circumstances the conclusion of any contract with the Soviet government would be futile and, as stated in our letter to Mr. Krassin, we prefer to remain as heretofore claimants against Russia for damage caused by the Soviet government for unlawful appropriation of our properties and working capital.

While in Moscow I had the opportunity of seeing a number of our employees and engineers who had recently come from the properties, and who had first-hand information not only as to the physical condition of the mines and works but also as to the attitude of our workmen and employees.

This information is reassuring as to the general good feeling among the people and of the condition of our properties at Kyshtim, Ridder, Ekibastus, and Tanalyk.

While the directors keenly regret that, notwithstanding all their efforts and their strong desire to resume operations in Russia, an agreement at the present time is impossible, they are satisfied they are acting in the best interests of the shareholders and that the position of the company will be strengthened by the decision and attitude thus adopted.

Yours faithfully,

Leslie Urquhart, Chairman.

London, October 11, 1921.

Leonid B. Krassin, Esq.,

Russian Trade Delegation,

Dear Mr. Krassin,

At our meeting yesterday I had the honor of informing you personally that on my return from Russia I submitted the draft concession contract to my colleagues on the Board of the Russo-Asiatic Consolidated to whom, as well as to some of the principal shareholders, I tendered my views on the conditions in the draft contract and on the position in Russia generally.

I was naturally unable to report fully to the shareholders of the company until I had the advantage of discussing with you the position in detail, and I have now repeated our conversation to my colleagues and it is my duty to inform you that I am authorized by my Board on behalf of my company to the effect that the measure of disagreement between us and the Soviet government on vital points of the draft contract is so great, the attitude of the Soviet government and the present political and economic conditions in Russia so impossible, that we cannot see our way at present to continue negotiations for the return of our properties, and prefer to remain as heretofore claimants against Russia for damages caused by the Soviet government for unlawful appropriation of our properties and working capital.

Your unfailing courtesy to me personally both before and during my visit to Moscow convinces me that I should be failing in courtesy to yourself if I did not give you in detail our reasons for coming to the above conclusion.

I need hardly remind you of the sincere desire which we have always evinced to resume work if possible in Russia and you will no doubt agree that we have shown our complete willingness to go a very long way in meeting the communist views of the Soviet government and that we did actually yield on many points, hoping by so doing we might be privileged to assist in re-establishing the economic life of that country and of giving bread to the starving and miserable workpeople at least on our own properties.

In the speech delivered on behalf of the Board at the general meeting of shareholders of the company held on July 6 last, I referred to the negotiations with yourself as representative of the Russian Soviet government in this country, which were inaugurated after discussion with and on the advice of the Board of Trade.

In reviewing the position in the speech we were under no illusion as to the facts of the Russian situation. We pointed out that Russia under her present communist system of state economy produces nothing to trade with, that the process of unlimited emissions of bank-notes has utterly exhausted the remnants of credit and that the stocks of products and materials of the old capitalistic system had been used up. The abolition of rights to property, of economic freedom and the complicated system of economic restrictions generally have killed individual initiative and enterprise while the elimination of private gain had destroyed all incentive to work and produce. The policy of nationalization of all industry and trade had killed foreign credits, and foreign capital without which the resuscitation of Russian industry will be difficult, if not practically impossible, would not be forthcoming if the present economic system were to continue.

On the other hand we believed it was the pressure of these inexorable facts, the stagnation, exhaustion, and suffering to which the communist system had brought the country that had forced the Russian situation from the beginning of this year to enter a new phase. In the Decree of March 30 last, which gave permission to peasant and town workers to barter and to trade, in the corn-tax replacing the forcible requisition of surplus grain from the peasant, in the denationalization of small industries, in the offering of concessions to foreign capitalists on terms which admitted the principle of private gain, we saw the beginnings of the re-establishment of favorable conditions for the resumption of industrial life in Russia.

Finally, we had in the negotiations with yourself further proof of an evolution to the right in the strivings of the moderate elements in the Soviet government to adopt an economic system and create an atmosphere in which foreign and Russian capital could operate and restore Russia to her former strength.

We made it perfectly clear in starting negotiations that we did not look on Russia exhausted and suffering as a hunting ground for this or that commercial advantage; we were not self seekers or exploiters of other people's distress. All we asked for was the return of our properties in the condition they were in when nationalized, together with our working capital. We emphasized that we were not concerned as foreigners with the politics of Russia and that our only desire was to see the return of prosperity to that great country and to us as shareholders in this company and finally that if the negotiations did not lead to the complete and satisfactory re-establishment of our business in Russia it would be through no fault of our own, but through the fault of the Soviet government.

There are in all 27 clauses in the draft concession agreement. I will refer first to the 9 clauses in the draft contract regarding which it was impossible to come to an agreement and will deal later with the proposed contract with the Professional Workmen's Union, which the Soviet government stipulated must be supplemental to and part of the concession agreement.

Clause 2.

With reference to the return of all the properties of the Russo-Asiatic Consolidated to the company under form of a concession, the Soviet government proposed to exclude those lands which have been assigned or have to be assigned to the local population in accordance with the land settlement scheme of the Soviet government. This clause could not be agreed until the land to be demarcated and the new regulations under which the land, mineral and timber rights to be assigned were clearly defined.

Clause 4.

With reference to the return of our losses and working capital no definite agreement was come to.

Clause 5.

Referring to State control and new timber-felling regulations at Kyshtim and other properties of the concession: this could not be agreed until State control with reference to the new forest and timber regulations to be substituted for the old forest regulations, and the words "actual laws and regulations," be clearly defined.

Clause 7.

Could not be agreed until the instructions to accompany the decree referring to minerals to take the place of the old mining code were clearly defined.

Clause 15.

With reference to royalties payable on sales in lieu of taxation, the amount of royalty could not be agreed. It is obvious, as has been documentarily demonstrated, that the company could not pay the royalty demanded without loss. The company refused to consider an Excess Profits Tax.

Clause 19.

My draft of this clause stipulated that all workers employed by the company, whether Russian or foreign subjects, should be regarded as engaged on work of State importance and should not be liable to labor conscription or to any kind of forced labor generally; their property to be free from any special local taxes or charges, requisitions and confiscations; their homes free from regulations limiting living space, emigration and other similar measures of force. That all searches, arrests and extraction of papers or documents should only be carried out against employees and workmen on the concession by decision and in the presence of the justiciary organs. Further, that qualified workmen and employees were to be free from military service and mobilization and on an equality with persons employed in the most important State enterprises.

The Commission refused to agree to my draft and substituted another limiting the above privileges, and even then only with reference to foreign subjects—Russian citizens working on the concession were to be subject to all these restrictions and limitations of their liberty.

Although I protested strongly against this unfair discrimination in favor of foreign as against Russian working men on common grounds of humanity, equality and justice, the Commission insisted on their wording of this clause.

Apart from the economic absurdity of agreeing to conditions whereby any one of the local organizations of the Soviet government could take a highly paid Russian employee, brain worker or skilled workman, away from his productive work on the concession and force him to clean the streets or do any other unskilled labor, and even although this is the practice at present, speaking for myself, for my colleagues and I am sure for every one of the shareholders of this company, we could not become parties to a contract containing a clause so humiliating and so unjust to our fellow-workers.

Clause 24.

Referring to period of concession. The Commission offered a 72 years' lease. The company insisted on a period of 99 years for the concession, in view of the fact that the Kyshtim property is freehold and that the other properties were held either until exhaustion or under long leases which could, no doubt, have been renewed if required.

Clause 25.

Referring to right of purchase of properties by the Government after term of years: I considered this clause should have been deleted, but in any case the conditions proposed by the Soviet government are unacceptable. If such a clause is to be retained the company insists on my wording.

Clause 27.

Arbitration. All disputes and misunderstandings as to

the meaning of or fulfilment of the Concessions Agreement and of additions or subsidiary agreements thereto to be referred to a permanent Arbitration Commission consisting of three members, one member to represent each side, the third or president to be elected by mutual agreement. Failing such agreement the Commission proposed that the president, who must be a Russian, would be nominated by the Russian Academy of Science. The company insisted that, failing agreement, the president, who must be a neutral, neither a Russian nor a British subject, be nominated by a foreign society, preferably the American Institute of Mining and Metallurgical Engineers.

As communism does not recognize the right to private property on which the previous civil and criminal code was based, magistrates have been suppressed and courts of justice have been abolished. Nothing has been substituted for these except a so-called Court of Revolutionary Conscience. Under the new system, taxes have been abolished, the mining, factory, customs, forest and railway laws and regulations, in fact all previously existing authorities have been destroyed, as is evidenced by the clauses of the draft concessions contract reviewed in this letter, and nothing but incomplete decrees and instructions which are issued daily have taken their place. Further, the communistic system does not recognize any obligations between individuals and therefore no contract or obligation between two persons can be enforced; nor does the State itself recognize any obligation to individuals or subjects. The only obligation recognized and enforced is the absolute subjection of every individual to the State.

This extraordinary position, the absence of all laws and regulations, dominated as you are aware the discussions all through the negotiations. The suggestion made by the Commission that questions in dispute or of civil law should be referred to the Courts of Revolutionary Conscience was impossible of acceptance, firstly because the members are not of too high intelligence, have received no legal training and all belong, without exception, to the communist party. As the communist creed does not recognize private property or that capital has any rights, judgment would naturally always be adverse to capital. This view was accepted by the Concessions Commission, and in order to meet the requirements of justice with reference to any issues which might arise in the working of the concession contract it was agreed that a court of arbitration was the only solution.

I can quite well understand the contention put forward at the meeting of September 12 that the Soviet government considers it undignified that questions of dispute between the government of Russia and a Concessionaire on Russian territory should be adjudicated by a foreigner appointed by a foreign scientific society. On the other hand the condition that the president or arbiter of the Arbitration Commission be a foreign expert nominated by a foreign scientific body was of vital importance to the company. It is the only safeguard (and at that only a moral safeguard so long as present conditions of lawlessness exist in Russia) that the terms of the contract would be interpreted in all fairness and justice for both sides by an unprejudiced umpire.

The acceptance of the proposal of the Soviet government would entail the danger that a communist might be appointed president of the Arbitration Commission, who for obvious reasons could not be expected to render justice to capital; but even if he did not belong to the privileged communist party no man is a free man in Russia today; he is subject to labor conscription and forced labor, to every kind of restriction in his home or on his liberty of thought or movement, he is always in a position of absolute subjection to the communist state and, indeed, he and his family are dependent for their daily ration of food on the Government. How then can he be considered a free agent in adjudicating in a dispute between the Soviet government and the concessionaire?

All-Russian Council of Professional Unions.

I now come to the proposed supplemental agreement with the All-Russian Council of Professional Unions, which is to form part of the concessions contract, this council being a department and organ of the Soviet government. This document is too long to review in full; I will, therefore, refer to only a few of the principal clauses.

To call this union a professional union seems to me a misnomer, for whether he desires it or not it is obligatory for every man or woman worker in Russia be he a brain worker, a doctor, lawyer, mining, civil or mechanical engineer, a skilled craftsman or unskilled laborer, to be a member of this union.

Clause 2 covers in the collective contract 39 different categories of skilled workmen alone whose rates of pay are based on wages paid in England and Germany, but it is beyond the skill of mortal man today to fix the rate of exchange; and further the conditions are not the same, as you know; the skill and capacity of the Russian workman is not nearly as high, the undertaking has got to house him and also supply him with food and all the necessaries of life, which naturally entails a great increase in the working capital of the undertaking. I proposed that the rates of pay should be those paid in 1913 on the gold basis for the rouble, and although this was equivalent to a minimum of eight times what is being paid in State enterprises at present and would have been hailed with joy by the workmen, the proposal was refused by the All-Russian Council of Professional Unions.

Clause 9. The concessionaire is obliged to inform the professional unions of every engagement and every discharge of workmen. The transfer of persons employed in State enterprises to the enterprises of the concessionaire is only permitted on the same conditions as the transfer from one State enterprise or department to another. This means that without the permission of the heads of the department or State enterprise concerned as well as of the All-Russian Central Professional Union, a workman or employee may not, even if he desires to do so, enter the employment of the concessionaire. As all enterprises are State enterprises today the restriction on the personal liberty of the workman and the freedom of the concessionaire in operating and developing his enterprise is self evident.

Clause 13 insists that the concessionaire is obliged to purchase from abroad for a period of not less than seven years for the personal needs of the workmen and their families all food, provisions, clothes, boots, etc., and sell these goods at cost price. I pointed out that it was illogical that a period of seven years should be fixed in advance and that it was unreasonable to force the concessionaire for a period of seven years to bring, for instance, flour and provisions from America, a distance of not less than 10,000 miles from the Ridder property, when there is today wheat alongside in the Akmolinsk province which cannot be moved by the Soviet government. I suggested that if the professional union desired to safeguard the interests of the workmen we should be obliged to buy in the cheapest market and sell at the cheapest price instead of being asked to do the opposite. This suggestion was categorically refused and the professional unions insisted on their conditions.

All kinds of controls and provisions are made whereby the liberty of action and decision of the concessionaire are restricted by the professional unions; as a result there is no finality to an agreement with a workman even after the terms of his contract with the enterprise have been absolutely fulfilled.

The All-Russian Council of Professional Unions, supported by the Che-ka or Extraordinary Commission (both controlled by the communist party) is simply a political in-

strument for forcing on the Russian workers the extreme principles of international communism through the mechanism of the Government.

As you are aware some of the provisions of the draft contract are not in the economic interests of the workmen and have the effect of not only restraining the liberty and enterprise of the employer, but the personal liberty of the worker. Instead of permitting the worker and employer to come together to settle any differences amicably as in the past, the contract with the All-Russian Council of Professional Unions is intended to keep the employer and the workers apart, and by placing the interests of the workers in the hands of extremist members of the communist party or opportunists who are at the head of this organization, perpetuate the present strangle-hold not only on industry and enterprise but on the whole working and proletarian population of Russia.

I need not elaborate on this supplemental contract further as although we had lengthy discussions with its representatives no agreement was possible with the representatives of the professional unions.

It is with great diffidence, in view of its political aspect, that I am obliged to deal with the influences which the Che-ka or Extraordinary Commission for combating counter-revolutions would have on the fulfilment and operation of the concessions contract.

I quite realize that in times of revolution and more especially when an infinitesimal minority govern the destiny of a country, that plenary and arbitrary powers must be given to a police organization for combating counter-revolutionary activities. For this reason and although it may be that the leaders of the communist party or of the government were idealists and at first averse to violence, they found themselves obliged to resort to violent methods to keep themselves in power, and in order to establish their communistic system on an unwilling people. It was natural, therefore, that in destroying the former order, the process of nationalization and confiscation of all property brought about a period of anarchy, plunder, and loot. The Che-ka was the principal instrument in enforcing these measures, it rallied round itself not only communists, but criminals, both Russian and internationalists. The Che-ka is accuser, judge, jury and executioner with absolute power of life and death, and in addition to these plenary powers granted to it, this secret police has developed the most complete spy system of informers and agents provocateurs throughout every town and village of the Russian dominions.

For these reasons the power of the Che-ka has today eclipsed that of the Soviet government. History has shown that an organized and armed minority can by terror control an unorganized majority. By methods of calumny, corruption, and murder, the Che-ka controlled by the extremists of the communist party and their conscienceless tools, has established such a reign of terror that it keeps not only the Russian people in abject subjugation but even the leaders of the communist party, who are obliged to submit to their interference in the political and economic life of the State.

Every phase of the individual activity of the employer, his staff and his workmen in the operation of the proposed contract, even in the privacy of their homes, would be under the shadow and menace of this terrorist organization.

It logically follows, therefore, that with the abolition of the code of civil laws and all the legal authorities and regulations that govern the political and economic life of a nation there can be no justice. As long as the communist party controls the Soviet government, the Third Internationale, the Che-ka and the professional unions, any one of these instruments of the communist party may render inoperative any agreement which may be come to with the Soviet government.

May I also say that so long as the Third Internationale, not content with the devastation of Russia by its communist system, is permitted by the Soviet government or communist party to continue its subversive efforts against the institutions of capitalistic countries, I do not see how it could be possible to obtain the finance and credits so necessary for the life and development of industry in Russia.

Allow me to say in conclusion that I had, as you know, very full and reassuring information as to the condition of our properties, which went to show that given a fair opportunity the time necessary to rehabilitate our business would by no means be so great as might be expected.

Our workmen and employees at all of the properties were pathetically anxious and hopefully waiting for us to resume work. I had many personal messages of goodwill and assurance on this point, and it is a matter of the keenest regret to me and my colleagues and shareholders that notwithstanding our sincere and anxious desire to re-start work and provide again for the well-being of our workpeople and their families, we are prevented from doing so for the reasons above given.

As the interest in these matters extends beyond the parties immediately concerned in these negotiations, I reserve the right to such publication as we may deem advisable.

Believe me, yours faithfully,

Leslie Urquhart, Chairman.

THERE is no standard classification of asbestos in general use, states an Arizona Bureau of Mines bulletin, but the Department of Mines of the Province of Quebec recognizes the following five grades. Crude No. I, Crude No. II, Mill Stock No. I, Mill Stock No. II, and Mill Stock No. III. Some mines ship only No. I Crude, others both No. I and II Crude, while still others send the whole product mined to mills which may produce from two to five different qualities of mill fibre. In order that prospectors may have some conception of the probable classification of good asbestos the following table has been prepared:

Quebec Department of Mines classification	Approximate length of fibre
Crude No. I	Over $\frac{3}{4}$ in.
Crude No. II	$\frac{5}{16}$ to $\frac{3}{4}$ in.
Mill Stock No. I	$\frac{5}{16}$ in. and over
Mill Stock No. II	$\frac{1}{32}$ to $\frac{5}{16}$ in.
Mill Stock No. III	Up to $\frac{1}{32}$ in.
Asbestic	Very short fibres mixed with powdered serpentine

Although the length of the fibre is an important factor in determining the grade and market price of asbestos, the value is also dependent upon the fineness of the fibres, the temperature at which they fuse, their flexibility, and their tensile strength. The value of chrysotile does not decrease in direct proportion as the length of fibre decreases. For instance, if fibre $\frac{1}{2}$ in. long, which might be worth $1400 to $2000 per ton, were broken in half, the resulting material might be worth only $110 to $150 per ton. The fibrous structure, toughness, incombustibility, and low heat conductivity are the properties that make asbestos valuable. The most important way in which asbestos is utilized is as yarn or thread, used in the manufacture of steam packing, fireproof cloth, rope, and brake-linings. No known substitute is available for the manufacture of the better qualities of these articles.

Book Reviews

First Aid and Rescue Work in Mining. By L. G. Irvine. 348 + xv pp., ill. South African Red Cross Society, Johannesburg. For sale by the 'Mining and Scientific Press', sole distributors in the United States, Canada, and Mexico. Price, $2.

Dr. J. S. Haldane, who writes a prefatory note for this excellent little volume, remarks that, outside South Africa, Dr. Irvine's name is probably best known as a result of his papers on miners' phthisis and on the effects and treatment of poisoning by nitrous fumes. During the War there were numerous cases of poisoning in naval actions by nitrous fumes from burning explosives; the lung irritant gases employed so extensively in land warfare were similar in their effects. Many soldiers and sailors owe their lives to methods of treatment that were first introduced in this connection by Dr. Irvine and his collaborator, the late Dr. Macaulay. To those familiar with underground conditions and the special dangers of mining, it will be evident that the author has studied carefully all the recent advances of knowledge and their practical application. The chapters dealing with the safe transport to surface of injured men, with accidents from all varieties of poisonous and suffocative gases, with explosions and fires, and with rescue apparatus for use in suffocative air, embody all the results of recent investigations and practical experience. In the first part of the book the author has endeavored to meet the needs of all classes by placing in smaller type, or where they occur in the general text by enclosing in brackets, such portions or terms that a trained ambulance man ought to know but that an elementary student need not learn. Part I may therefore be used as a text-book for general courses in first aid. The description of methods include none but those that an extended personal experience of first-aid work in mines has shown to be reliable. Part II deals with special requirements. A large portion discusses accidents due to poisonous gases and the use of rescue apparatus. The contents of the book are arranged as follows: I. General structure and working of the body. II. Bandaging; the triangular and the roller bandage. III. Circulation of the blood; treatment of wounds and hemorrhage. IV. Fractures, dislocations, and sprains. V. Respiration, artificial respiration, and asphyxia. VI. Insensibility and unconsciousness. VII. Burns and scalds; injuries due to electricity; injuries to the eye, ear, and nose; snake bite. VIII. Poisons. IX. Transport of the injured; general management of first-aid cases. Appendix A deals with the contents of the standard first-aid box and Appendix B describes the Thomas extension splint for the thigh. The book should be in the hands of all who are responsible for the lives of others.

Steam Boilers. Edited by T. Croft, assisted by I. O. Royse, I. V. Le Bow, A. J. Dixon, and E. R. Powell. 412 pp., 5½ by 8, ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

This book was written as a practical treatise to help those who intend to enter for engineer's license examinations; it has been prepared primarily for men of little schooling who desire to acquaint themselves regarding the subject. A working knowledge of arithmetic will qualify anyone to read it intelligently; but it may be used effectively by others, regardless of training or experience, who seek information on steam-boilers. The principles presented throughout the text are explained by means of descriptive expositions or with arithmetical examples. At the end of each of the 25 divisions there are questions to be answered by the reader, and, where justified, problems to be solved. Detailed solutions of all the problems are printed in an appendix at the end of the book. The functions, the history, and the modern types of boilers are first considered. The boiler codes and laws are discussed. The elements of modern boiler construction are presented under: boiler stresses and strengths, riveted joints, braces and stays, fire-tubes and water-tubes, manholes and handholes. This is followed by matters relating to boiler accessories, steam-generating and superheating, boiler capacities, and ratings. The subject of boiler-room economy is dealt with under: fuels; draft and its production and measurement; combustion and firing; boiler settings and furnaces; mechanical stokers; petroleum and gaseous fuels; chimneys, breechings, and dampers; artificial draft equipment; fuel economizers; feed water and feed-water treatment; steam-boiler management, inspection and maintenance. The book will be found of value to the average engineer who is concerned with the work of boilers but who does not specialize in the subject. It has been excellently illustrated with special drawings. The only adverse feature that should be corrected in a future edition is seen in unnecessary capitalization in the bold-face type introducing the paragraphs.

Silver Bromide Grain of Photographic Emulsions. By A. P. H. Trivelli and S. E. Sheppard. 143 pp., ill. Van Nostrand Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.50.

The research laboratory of the Eastman Kodak Co. was founded in 1913. The results obtained are published in various scientific and technical journals; but the work on the nature of photography is so varied that it has been thought wise to prepare a series of monographs, of which this is the first to be published. It is hoped to cover the whole field of scientific photography. In the present treatise it is shown that the fundamental units of the sensitive materials used in photography are the small grains of silver halide that, inbedded in the gelatine, form the emulsion. These grains are of small size; they are precipitated in a colloid medium and have been considered as colloid aggregates. The result of study involving photo-micrographic work of a high order is to show that the grains of high-speed emulsions are crystalline and all belong to the same crystalline class. The catalysis of crystallization by nuclei is suggested as an explanation of some of the effects produced by the admixture of silver iodide with silver bromide in an emulsion, and the fact that traces of colloidal silver make the grains color sensitive is believed to be related to this. The contents of the book are as follows: I. The influence of ammonia on photographic emulsions and a theory of ripening. II. Von Weimarn's theory and the determination of the dispersity of silver bromide precipitates. III. Accessory factors influencing the dispersion of silver bromide emulsions. IV. Crystallization catalysis. V. Capillarity and crystalline growth. VI. Experimental study of the crystallization of silver bromide. VII. Classification of silver halide crystals. VIII. Silver bromide crystals of photographic emulsions. IX. Directions of most rapid growth in silver bromide crystals, and the occurrence of anomalous forms. X. The behavior of silver bromide and silver iodobromide crystals in polarized light. The book concludes with a summary of crystallographic study of silver halide grains, a bibliography, and indexes to authors and subjects.

Petroleum. By H. M. Petroleum Department with the co-operation of H. B. Cronshaw. John Murray, Albermarle street, London, W. Price 5s.

This is one of the series of monographs that is being prepared under the direction of the Mineral Resources Committee of the Imperial Institute. It contains facts, and statistics in tabulated form, relating to the world's resources of petroleum as determinable from present information. An extensive bibliography is appended.

THE HECLA-STAR CONTROVERSY

Extensive propaganda is being used by Eugene R. Day and associates in order to prevent the purchase of the Star mine, in Idaho, by the Hecla company. The American Smelting & Refining Co. is behind the Day interests, who control the Northport smelter, in Washington. The abandonment of this plant would mean the elimination of the only independent smelting concern in the vicinity; and future competition in the lead-smelting industry would be confined to the Bunker Hill & Sullivan and the American Smelting & Refining companies. The case to be tried shortly in Spokane is a secondary issue, but it is one that is complicated by the fact that the Bunker Hill company, before entering into negotiations with the Hecla company, had taken a purchase option on the Star mine. The Federal Mining & Refining Co., a Guggenheim subsidiary, entered Star ground and removed, according to the estimate of the Star company, ore valued at several million dollars.

COPPER SALES DURING OCTOBER

Sales of copper during October amounted to 140,000,000 lb., the largest for any month this year. The increase is accounted for mainly by advance-buying on the part of domestic consumers who had become frightened lest producers would boost the price considerably during the next few months. Included in October sales are large tonnages for December and first-quarter, 1922, delivery. During October one large consumer covered his requirements for all next year. It is this advance buying rather than any sudden increase in domestic or foreign consumption that accounts for the unusual size of the sales despite business being exceptionally quiet for more than a week during the last half of the month as a result of the threat of labor troubles upon the railroads. Monthly shipments to consumers have averaged about 80,000,000 lb. per month recently. Despite aloofness of British buyers during the month, foreign sales were good. Japan was a large buyer, induced by the prospect of rising prices, while Germans rushed to fix their fast-depreciating marks into copper of surer and more certain value. Sales to France were encouraging throughout the earlier part of the month.

RESUMPTION OF OPERATION OF INTERNATIONAL SMELTER AT MIAMI

The International Smelting Co. will re-start part of its plant at once. This, however, does not mean that the Inspiration Consolidated Copper Co. will resume mining, as was reported in some quarters. Officials of the latter company explain plans in the following statement: "The International Smelting Co., which treats the concentrates of the Inspiration company, also smelts concentrates of the Miami Copper Co. This smelter has been shut-down since last March when Inspiration and other copper mines ceased production. Miami has continued production steadily at the rate of about 4,250,000 lb. per month. International has been receiving and storing concentrates of Miami. Under its smelting contract, International must return copper from these concentrates within a definite time. Thus far it has been able to deliver copper due Miami from other stocks and has stored concentrates produced by Miami. Its storage capacity has become taxed, and, in order to make deliveries required by its contract, the smelting company has been obliged to start operations in order to treat stored concentrates of Miami. Copper represented by these concentrates has been reported from month to month as though actually produced, and smelting of the concentrates does not mean any addition to stocks that have been already fully reported".

SAN FRANCISCO SECTION OF THE INSTITUTE MEETS AT BERKELEY

The regular monthly meeting of the San Francisco section of the American Institute of Mining and Metallurgical Engineers was held on November 9 at the School of Mines building of the University of California at Berkeley. The hour from 7 to 8 o'clock was occupied in the inspection of the Mines building. James M. Hyde gave an interesting address on 'What a Young Engineer can do in the Business World'. The meeting was well attended by the students in mining engineering in the University. The meeting was in furtherance of the plan to increase membership by arousing the interest of the younger engineers.

ASSAYERS REQUIRED FOR MINT-SERVICE

The U. S. Civil Service Commission announces an open competitive examination for assayer on December 7. Two vacancies, one for duty in Washington, D. C., and the other for duty in San Francisco, each at $2200 per year, exist. Appointees whose services are satisfactory may be allowed the increase granted by Congress of $20 per month. Applicants must have graduated from a four years high-school course or have completed at least 14 college entrance units of work. In addition, they must have completed at least one year's course in general and analytical chemistry in an institution of recognized standing; and have had at least two years practical experience in analytical work, at least six months of which must have been in metallurgical analysis. Special credit will be given for experience in the assaying of gold and silver.

CHIEF CONSOLIDATED PAYS DIVIDEND

The Chief Consolidated Mining Co. paid a dividend of 5c. per share on November 1. This called for the payment of $44,201, bringing the year's disbursements to stockholders up to $176,804, and the grand total up to $2,004,323. During the third quarter the company shipped 22,116 tons of ore, averaging 0.058 oz. gold, 33.276 oz. silver, 16.55% lead, and 1.10% copper. The metal production was 1142 oz. gold, 735,922 oz. silver, 3,270,749 lb. lead, and 3082 lb. copper. The average gross value per ton was $40.69; smelting, freight, and sampling charges, $18.55, leaving a net value of $22.14 per ton, or a total of $489,534. The net profit for the quarter was $72,940. During the period a total of 10,654 ft. of development work was done in the Chief mine and 160 ft. in the Plutus mine, which adjoins the Chief Consolidated property and is controlled by the Fitch interests.

ACTIVITY AT VIRGINIA CITY, NEVADA

A report is current, but unverified, that three of the north-end mines, the Con. Virginia, Ophir, and Mexican, are to be merged under a single corporate ownership and that a cyanide mill of large capacity, at least 1000 tons, will be built in the spring to treat the low-grade ore of the upper horizons in these mines. The Mexican mill, operated jointly by these companies with the Union and Sierra Nevada, is treating 120 tons daily from the Con. Virginia. This ore is the product of selective and rather costly mining on the 2000-, 2100-, and 2200-ft. levels.

At Gold Hill the haulage tunnel of the United Comstock Mines Co. is more than 75% completed, lacking only some 1300 ft. between the Knickerbocker and Belcher shafts. Hard rock has impeded progress here and this section may not be finished before February 1. Hoar electric shovels are used in driving both breasts. Foundations for the mill buildings, covering five acres, are progressing and concrete is being poured at the rate of 125 yd. daily. A steam-heating plant, just installed, will ensure against freezing in cold weather. The mill will treat 2500 tons of ore daily and the coarse-crushing plant will crush 2000 tons in eight hours. A director of the company is authority for the statement that the ore from the lode will be mined and milled for a total maximum cost of $2 per ton. In the Imperial mine alone 4,000,000 tons of mill ore has been blocked above the 400-ft. level. A 90-ft. cross-cut in the Trojan is said to have sampled $9 per ton. The new town built by the company in American Flat, at the portal of the tunnel, is to be known as Comstock; a postoffice will be provided.

A number of properties on branch veins or cross-fissures are being developed. The Pittsburg Comstock, headed by H. G. Humphrey, vice-president of the United Comstock, has re-opened an old 600-ft. tunnel entering the mountain from the Jumbo road, above the Belcher on the foot-wall side of the lode and adjoining the Trojan. The tunnel will shortly cut the Bright Star vein, extending from the Trojan at a depth of over 400 ft. below the upper tunnel and glory-holes that produced high-grade ore. The tunnel cuts a foot-wall vein containing good mill-ore. The product of this mine can be sent at small cost to the United Comstock mill and the property will be opened later from the haulage tunnel of the latter company. In the Scheels workings of the Comstock Silver Mining Co. good mill-ore has been exposed in considerable quantity, together with seams and bunches of high-grade. The Scheels tunnel workings have been connected with the Scheels inclined shaft and a drift from the bottom station is being advanced to connect with the main Overland shaft, a 550-ft. incline extending to the Scheels boundary. The company's 10-stamp amalgamation mill on the Overland is to be used for a short time by lessees working on the adjoining Lager Beer. The mill, electric hoisting machinery, assay laboratory, buildings, and equipment of the Comstock Silver Co. are in excellent condition. George Drysdale, the manager, expects to begin treating ore as soon as the Overland shaft is repaired. F. W. Royer is consulting engineer.

Albert Burch, consulting engineer to Boericke Bros. of Philadelphia, has commenced a second sampling of the so-called middle group of mines. The work will involve driving cross-cuts to the foot-wall of the Chollar & Potosi, a long drift north into the Gould & Curry, and probably the re-opening of the old Gould & Curry tunnel, the deepest adit in this section of the lode.

PESSIMISTIC VIEW OF FUTURE OF MEXICAN OILFIELDS

In discussing the Mexican oil situation and its bearing on American oil production, Joseph F. Guffey, the Pittsburgh oil operator, who recently returned from Mexico, is quoted as saying:

"The light oil reserves of Mexico amount to only 60,000,000 bbl. Before March 1, 1922, that country will become an unimportant factor in the oil-producing world. It is about time that the public woke up to the fact that America, and in fact the world, is now confronted with a most serious situation, due to the destruction of the major part of the light-oil field of Mexico by salt water and the menacing of the present small light oil-producing area of that country by water.

"This most unfavorable development in Mexican oilfields is benefiting and will continue to benefit all of the American oil producers. Great refining interests of America will have to depend more than they have for many years past upon American crude. Mexican light oil, when subjected to modern refining methods, produced a good volume of gasoline, kerosene, and lubricants; as a matter of fact, this grade of oil contained about 20% of the above-named valuable products.

"All of the bulk of Mexico's best grade has been produced from the Tampico-Tuxpam light-oil zone, a narrow strip running in a north and south direction from Dosbocas to Alamo. Practically all of the sections or pools located along that stretch of land have been exhausted of oil, salt water replacing it."

JAPAN CONTINUES TO PURCHASE ZINC

Japan continues the mainstay in the zinc-export trade of this country. In September for the sixth consecutive month Japan took by far the greatest proportion of our zinc exports. In the seven months ended with September shipments to Japan amounted to 2,242,016 lb., or 70% of this country's export trade in bars, pigs, slabs, etc., during that period. In September alone Japan took 98% of the total shipments, against 65% in August and July. France and the United Kingdom are still out of the market, not a pound having been exported to either of those countries this year.

THE TRAGEDY AT BRITANNIA BEACH

The latest reports place the death list in the flood, of October 28, at the Britannia mine, on Howe Sound, B. C., at 58; already 36 bodies have been recovered and 22 of the inhabitants of the town are still missing. It is estimated tha 50 houses have been demolished and about 200 people are homeless. F. J. Donohue, general manager of the Britannia mine, stated that the company would rebuild the houses as soon as the wreckage can be cleared away. Many acts of heroism are reported, among which may be mentioned that of the two watchmen who were patroling the creek and who easily might have got out of the way of the flood by climbing onto higher ground. Evidently, however, they preferred to try to reach the village to give warning to the inhabitants, and, being overtaken by the flood, were both drowned. This is the third serious disaster that has happened to the Britannia company and its employees within recent years. In the spring of 1915 a snowslide carried away the main boarding-house and eight other buildings, killed 54 men, and demolished the aerial tramway; while last February the 2500-ton concentrating plant, the first flotation plant to be erected in the Province, was destroyed by fire, fortunately without loss of life. The accompanying photographs show sundry scenes following the flood.

ARIZONA

Bisbee.—The Shattuck Arizona Copper Co. reports for the quarter ended September 30: total expenses, $76,467; net development returns, $20,857; interest received, $9953; total receipts, $30,810; net expense for quarter, $45,657.

Photographs Taken at Britannia Beach, B. C., After the Recent Flood

Kingman.—High-grade silver-gold ore has been found in the main drift on the G. A. R. claim of the White Hills Mining Co. This ore is similar in character to the first ore discovered in the G. A. R. claim. Larger equipment has been installed and it is planned to sink to the 1000-ft. level. For several months the 40-stamp mill has been under repair preparatory to operation on the low-grade ores that is blocked-out.

Oatman.—It is reported that the No. 3 shaft of the United Eastern Mining Co. has reached a depth of 840 ft. Development is expected to be carried on from the 850-ft. level if the present favorable showing continues. The shaft at the Big Jim Claim has reached a depth of 660 ft. and has reached the water-level. The tram from the Big Jim to the United Eastern mill is nearing completion.

Development, which is now being carried on by the United Eastern in the No. 3 shaft, which is near the United Western property line, has renewed interest in the holdings of the latter company. The United Western is now offering a block of stock to raise money for taxes and incidental operating expenses.

Prescott.—L. N. Wombacher has taken a contract to sink a shaft for the Gold Leaf Mining Co. of Cherry Creek. Preliminary to sinking the shaft, new machinery is to be purchased.——The Gold Leaf company's property adjoins, on the north end, the Logan property, where an 80-hp. boiler and double-drum friction-hoist now are being installed. A 10-stamp mill is in process of erection at the Logan, where engineers estimate there is ore to the value of $160,000 blocked-out above the two upper levels.

CALIFORNIA

Bridgeport.—The Pittsburg-Liberty gold mine in the Masonic district has been leased to H. C. Barnes and associates. The entire mineralized zone surrounding the mine will be prospected by the new owners.

Cecilville.—E. M. Robinson is drifting in the deep gravel bar below the junction of the East and South Forks of Salmon river. He has completed the wing-dam which turns the river toward the bank opposite his work and has built a long flume.——Harvey Bowerman is taking ore from a seam on his

Wild Irishman claim which adjoins the King Solomon mines at Canyon mountain.——Wallace McAnslan and William McClave have moved from upper South Fork to Canyon mountain and are working on a quartz prospect there.——Henry Ball is sawing lumber for his flume at the Jefferson Consolidated placer mine. He will begin laying flume and re-setting his pipe-line soon.——Daniel O'Shea is extending the tunnel at the Bowerman prospect on South Fork near Gibson gulch.——J. M. Lax & Sons will resume operations at the Root & Solsburg hydraulic mine. Recent rains have increased the supply of water in the creek.

Downieville.—The Sierra Buttes Mining Co. has excellent prospects in its No. 7 tunnel. Recent work has opened new ore which will be developed. Arrangements have been made with the owners of the Bigelow property, which adjoins the Sierra Buttes on the west, whereby the former will be developed through a tunnel on No. 9 level.——Ore from a 12-ft. vein is being milled in the Wheeler mill by Hughes & Cameron.

Grass Valley.—More than 50 tons of high-grade ore from the Julia Ross mine has been sacked and shipped to the Dull mill. The shaft from which the ore was taken is now 65 ft. deep.

Hayden Hill.—H. P. Anderson has prospected a north and south gold-bearing vein for 1250 ft. on the surface. In one pit he obtained ore assaying $12 per ton.

Redding.—The old smelter town of Keswick is rapidly fading away, as the Mountain Copper Co. shifts the scene of its activity to Matheson, the terminal of the new tram-line from the Hornet mine. Matheson is a new town on the Southern Pacific railway, three miles north of the site of Keswick; it will be the shipping point for the company's ores. Twenty of the 32 towers of the tram-line have already been erected.

San Francisco.—The annual meeting of the California Metal and Mineral Producers Association will be held at its offices in the Merchants National Bank building, in this city, on Wednesday, November 16, at 10 a.m. A full attendance is desired. Members who will not be present have been requested to execute and forward proxies at their earliest convenience.

COLORADO

Breckenridge.—Mines on Farncomb hill will be operated continuously this winter, and supplies have already been hauled in to last until late spring. The hill is famous for its rich wire gold, and, judging from the number of prospectors working in shallow shafts, new discoveries will result.——A shipment of sacked-ore was forwarded to the Leadville smelter recently from the Harriman lease on the Guyot; the ore was rich in silver.

Central City.—The Buffalo Chip mine has been leased and a contract let for installing a hoist and a compressor. The shaft is 175 ft. deep, with ore in the bottom level sampling 28 oz. silver and 0.63 oz. gold.——Concentrate assaying $50 per ton have been shipped from the Polar Star mill to the A. V. smelter at Leadville.

Creede.—Five carloads of ore have been shipped to the A. V. smelter by the Wabash M. & P. Co.; one car came from the Solomon group, operated by Del Norte men; and the Bether Leasing Co. has shipped $50 ore to the Leadville plant.——Operations have been resumed on the Manitoba and Ontario group by the Manitoba Leasing Co. Shipments from this Sunnyside property will start shortly on ore already blocked out.

Cripple Creek.—Directors of the Cresson Consolidated at a meeting held at Colorado Springs recently took no dividend action. It is expected that no dividend will be paid until the question of taxes on excess profits has been determined. Rich discoveries have recently been made at the 1600- and 1700-ft. levels; new shoots under development are reported sampling 6 and 7 oz. gold per ton. Between the 1100- and 1200-ft. levels an orebody 125 ft. wide by 200 ft. long is sampling $12 to $15 per ton as broken. For the three last days of October the average daily production, shipped to the Golden Cycle mill at Colorado Springs, was 250 tons.

The Vindicator company has started an extension of the Roosevelt tunnel, from its present terminal at the Portland, to cut through the Vindicator No. 2 shaft. Sinking has also been resumed from the station the the 2000-ft. level of the Vindicator.

Idaho Springs.—The Silver Cycle Mining Co., recently organized, is cleaning out the Wyoming Valley tunnel preparatory to extending the bore. The tunnel will unwater the Gold Medal group and Silver Age mines.

Leadville.—In Big Evans gulch the Dolly B. shaft is being re-timbered for the main air-shaft of the Yak tunnel.——The Ruby & Riach group in the Weston Pass district are active; high-grade silver-lead and high-grade zinc corbonate ores are being mined.

Ouray.—The mill-force at the Hidden Treasure has been increased and the plant is now operating at capacity; this will continue through the winter months.——A recent 20-ton shipment made by lessees on the Guadaloupe is reported as netting $2100. Another shipment leaves the lease soon.

IDAHO

Coeur d'Alene.—The Jim Blaine Silver Syndicate recently cut, at 150 ft., a blind vein in which galena has been found at intervals. This vein was unexpected, the first, or Jim Blaine vein, not having been expected until the tunnel had been driven 450 to 500 feet.

Homestead.—The Copper Syndicate enterprise is developing its ground through a 2500-ft. tunnel, by means of crosscuts and a winze. The vein is 25 ft. wide and contains some silver, gold, and copper.

Moscow.—At the east end of Moscow mountain, 10 miles north-east of here, placer mining is being carried on in a newly discovered district. The placer is on the homestead of George Saad, of Troy; the pay-dirt was discovered last summer by E. Williams, an old-time prospector. Five shafts have been sunk and dirt panned from these shafts goes from 15 to 55c. per pan. Black sand yielded $5.80 per ton when washed. A flume is being put in and 700 ft. of 10-in. steel pipe has been purchased and is on the ground. The fall and winter will be devoted to preparing to sluice the dirt next spring, when the first high water comes.

Orogrande.—Three feet of high-grade ore has been disclosed, according to Ralston McCaig, manager of the Summit Flat mine. The disclosure is in No. 2 vein on which a depth of 200 ft. has been attained. The width of the body has increased steadily from 18 in. Samples taken some time ago contained $21 gold per ton.

Porthill.—The Idaho Continental Mining Co. is shipping about 20 tons of ore daily and has about 1800 tons of concentrate on the dump ready for shipment.

MICHIGAN

Houghton.—Eleven furnaces are now in commission in the Lake district, including eight at the Calumet & Hecla smelter, two at the Michigan, and one at the Quincy. Production is approximately 27% of 1916, a normal year. Only 16% of the normal working mines are operating and 25% of the men are employed. Production in October was approximately 7,000,000 lb. This compares with a normal monthly production of 22,800,000.

Progress is being made with the rather unusual geological survey being conducted by a number of prominent geologists for the Calumet & Hecla Mining Co. The purpose of the investigation is to discover, if possible, the origin of copper and how it came to be laid down in native form in lodes or veins, rich in some portions and barren in others. The results to date, however, may be described as 'negative'. That is, if the survey were to stop now, the data available would enable a company seeking new copper deposits to determine whether to proceed with the work or stop it altogether when certain combinations of conditions were met. No results have yet been obtained, however, that would lead the miner directly to the copper in the lode without likelihood of failure, and it is toward that goal that the survey will be continued. The work that has been done to date is distinctly encouraging and it has more than justified the expenditure. It has overturned some pet theories and established facts which may be depended upon. A big saving will be made in the long run as a result of this research.

Not more than 1000 ft. of drifting remain to be done before the 81st-level haulage-way, which will serve Calumet & Hecla's conglomerate shafts, will be completed. No. 12 shaft, its southern terminal, will be used as a supply shaft and for the use of the miners, while Red Jacket shaft, the northern terminal, will become exclusively a hoisting shaft. The intervening shafts will be abandoned, eliminating the cost of maintaining expensive surface-plants, and the mining of the lode will be done from the haulage-way. This drift will lessen the cost of deep mining.

As expected, copper shipments out of the Lake district in October were the heaviest of the season. A total of 10,840,000 lb. was shipped by boat, and in addition it is estimated 2,000,000 lb. went out by rail. October water shipments compare with 7,028,000 lb. for September, 5,176,000 for August, and 8,322,000 for October 1920. October shipments by boat bring the total for the season of navigation up to nearly 41,000,000 lb. Estimated rail shipments are 10,000,000 lb., making total deliveries since May 1, 51,000,000 lb. Water shipments by months have been as follows: May (including a few days in April), 5,310,000 lb.; June, 5,858,000; July, 6,536,000; August, 5,176,000; September, 7,028,000; October, 10,840,000. The increase shown by September and October shipments is attributed largely to an improved demand for the metal rather than any particular desire to take advantage of lower freight-rates by the water route.

MONTANA

Butte.—W. J. O'Connor, assistant manager of the East Helena plant of the American Smelting & Refining Co., is quoted as saying: "It has been rumored that the American Smelting & Refining Co. has withdrawn from the custom-ore business in the Butte district. While it is true that we have found it necessary to place an embargo on the very low-grade highly-silicious ores, we are still in the market for those ores which will stand the necessary treatment charges".

The showing of copper ore on the 2200-ft. level of the Black Rock mine of the Butte & Superior Mining Co. has improved within the past week, according to reports. Ore showing in the face of the drift is 6 ft. wide and will average 4% copper with as many ounces of silver. This face is on one of three bands of copper ore uncovered by cross-cutting on this level; the bands are 8 to 10 ft. apart, and they will be cross-cut when drifting has progressed farther. Thus far only one band lying alongside the foot-wall has been opened, aside from the cross-cutting of the three when the copper vein was first opened on the 2200-ft. level, and as these two other bands show a width of about 3 ft. each, the prospects in connection with the development of this fissure on the 2600-ft. level are promising. A copper-ore stock-pile now is being reserved at the concentrator. About five months work will be required before the cross-cut now being driven on the 2600-ft. level reaches the copper vein, which appears at this time to be a 'northwester', in distinction from an east and west vein, as judged from its strike, and doubt is expressed that it is a branch of the Rainbow. Cross-cutting on the 2600-ft. level will place the Butte & Superior comparatively close to the ground of the Butte-New York, which it controls.

Terminal of the Government Railroad at Anchorage, Alaska

NEVADA

Barcelona.—Motor-trucks are hauling concentrate to Tonopah from the new flotation mill of the Con. Spanish Belt Silver Mining Co. The mill is operating two shifts and is producing daily 2000 lb. of concentrate from tables and 1000 lb. from the flotation machines.

Candelaria.—Meetings held in New York, Chicago, and Reno in the past ten days have resulted in an arrangement by which the Rochester Silver Corporation, operating at Rochester, Nevada, will advance funds for building a mill to treat the product of the Candelaria Mines Co. The Candelaria directors some time ago authorized an issue of interest-bearing notes to raise funds for a mill. The Rochester company will provide the necessary money up to $200,000, and in its Rochester Combined mill it has new mill equipment that can be utilized in the Candelaria plant. C. D. Kaeding, manager and consulting engineer, estimates the Candelaria reserve at $3,436,000 gross value. Mill-ore,

chiefly above the 200-ft. level in the Lucky Hill mine, contains 14 oz. silver and $1 gold per ton. Dumps and stope fills contain 9.7 oz. silver and a small quantity of gold. A branch of the new Mineral County power-line will be extended to the Candelaria plant.

Cortez.—The old Fitzgerald mine, forming the most easterly part of the Con. Cortez Silver properties, has been reopened above the bedded quartzite zone, in the upper limestone, and recent sampling here is said to give promise of a large tonnage of good mill-ore. This area was worked when only high-grade ore could be mined with profit. The double raise from the Arctic tunnel, 360 ft. below the Garrison adit, is advancing in the main porphyry dike that cuts the mountain. Two of the secondary fissures in the limestone, containing high-grade primary sulphide ore, were cut by the lower adit.

Rochester.—From a two-week clean-up at the Rochester Silver Corporation mill a bullion shipment valued at $40,407 was sent to the Mint. This is the largest shipment in more than two years. Frederick Sawyer, the secretary, reported current assets $274,617 and liabilities $33,521 at the close of September.

Tonopah.—The Royston mining district, 28 miles north of Tonopah, has been organized, embracing a part of the old San Antone district. High-grade silver ore was found on the Betts lease on the Hudson property in September. A small shipment sent to Tonopah assayed 944 oz. silver and $25 gold per ton. The Hudson Mining & Milling Co. has granted 13 leases. W. H. Royston, for whom the district is named, is manager for the Hudson company and superintendent of the Tonopah Belmont mill. The Hudson company is controlled by the Walker brothers, of Salt Lake City.

Engineers of the Tonopah Mining Co., as the result of recent sampling, estimate the reserve in the Tonopah property at "more than a year's supply in excess of earlier estimates".——The West End Con. is driving a raise in the Tonopah 76 ground from the 800-ft. level, indicating that this work is nearing the vein. The company is developing its recently acquired Mabel group at Garfield, north-west of Mina.——Deep levels of the Tonopah Extension are opening ore of great width in the Victor territory, notably on the 1680- and 1760-ft. levels.——The latest bullion shipment from the Tonopah Belmont, from the usual 15-day clean-up, was valued at $124,500.——Tonopah Divide in September shipped to the Belmont mill 1515 dry tons assaying $29.05 per ton, total gross value $51,200. Similar output was maintained in October. The sinking-hoist has been moved to the 1100-ft. station. A cross-cut is advancing south on the 800-ft. level, near the Gold Zone boundary, to prospect the gold-bearing zone opened by the main drift.

UTAH.

Alta.—The South Hecla Mines Co. will undertake extensive development of its 1300-acre tract during the coming winter. In the Albion property the adit is in about a mile and is nearing what is believed to be the downward extension of important orebodies found on upper levels some years ago. Most of the development work will be carried on in that part of the property. During the summer, mines in Alta are troubled with heavy flows of water, but during the winter they are comparatively dry and in the best condition for exploratory work.

American Fork.—An important find has been made in the Silver Wave claim, under lease to the American Leasing Co., of which Karl Ferlin is manager. Some time ago the Globe Consolidated Mining Co. was given permission to drive a long tunnel from the Holden tunnel through the Silver Wave claim, to gain access to ground belonging to the Globe company. This tunnel has been driven at the rate of 5 ft. per day, and recently its course was directed across the Read & Benson lime-beds, which have been highly productive in the past. A full face of rich copper-gold-silver ore was cut in driving the tunnel. Samples of the ore show chalcopyrite, chalcocite, and silver sulphide.

The Silver Contact Mining Co. has let a contract for driving a tunnel at its property, about 7 miles up the canyon. In 1918 a shaft was sunk to a distance of 45 ft. and bunches of high-grade ore were found. A tunnel was started 150 ft. below the shaft, and after being driven 100 ft. was stopped.

Bingham.—Fire has again broken out between the 1400 and 1500-ft. levels of the Utah-Apex mine, and gas has penetrated some of the workings of the Utah-Consolidated mine. The fire started in 1917 but was controlled. Additional bulk-heads will be constructed in both mines at once.

Box Elder County.—The new tunnel being driven at the Vipont Silver Mining Co. is now in a distance of 650 ft. It is being driven forward at the rate of 200 ft. per month. The portal of the tunnel is but 200 ft. distant from the concentrating plant and will reduce tramming distance about 2200 ft. It is expected the tunnel will enter the mineralized zone at a distance of 1800 ft. from the portal. The ore contains native silver and silver sulphide; it is a replacement in a silicious black limestone. Concentrates are shipped 26 miles to Oakley, Idaho, the nearest rail point. About 250 men are employed at the property; it is one of the largest producers in Utah at present.

Eureka.—Shipments of ore during the week ending October 29 totaled 168 cars, as against 172 carloads the previous week. The Tintic Standard shipped 66 cars; Chief Consolidated, 48; Victoria, 11; Dragon, 9; Eagle & Blue Bell, 7; Iron Blossom, 7; Centennial-Eureka, 6; Swansea, 4; Colorado, 3; Alaska, 2; Bullion-Beck, 2; Tintic Drain Tunnel, 1; Gemini, 1; and Eureka Mines, 1.

The Tintic Milling Co. is again taking ore from the Dragon mine, under lease. Production was discontinued some months ago on account of a cave. About one carload of ore per day is being sent to the Tintic mill, according to Richard Eataugh, who is superintending the mining operations in the Dragon property for the Tintic Milling Co.

The Zuma Mining Co. has let a contract for sinking the shaft from the 1000 to the 1200-ft. level. F. J. Fennell, manager of the property, will start exploratory work at that depth.

The Iron King Mining Co. has suspended shipments of iron ore to the American Smelting & Refining Co., owing to a surplus of that type of ore at the Murray and Garfield smelters. B. F. Grant, who is in charge of that portion of the mine under lease to the A. S. & R., has reduced his force considerably, and those who are retained on the payroll have been put on development.

Logan.—The Mineral Point Mining Co., owning claims in East canyon, has driven two tunnels; the upper one is in a distance of 140 ft. and the lower a distance of 100 ft. An orebody encountered by the upper tunnel assays 22.75% copper, with small quantities of gold and silver. The lower tunnel, at a distance of 75 ft. from the portal, struck a vein, assays of which show as high as 42.6% copper. Andrew Madsen is in charge of the property.

Park City.—Ore shipments for the week ending October 29 totaled 2140 tons, as compared with 1886 tons the preceding week. The Judge allied companies shipped 937 tons; Silver King Coalition, 722; and the Ontario, 481.

WISCONSIN

Benton.—The Block-House Mining Co. has combined with the McGuire-Sally Waters interests and a surface rig will be provided without delay. The mine shows extensive deposits of smithsonite at the 60-ft. level, while in the lower openings, at a depth of 110 ft., four 'blankets' of high-grade zinc

ore are shown.——The sale of zinc tailing has assumed formidable proportions. The material is now used largely in surfacing highways. The Carroll Construction Co., of Milwaukee, has contracted the tailing at the Fox mine. A spur has been built to the mine, and shipments are now being made at the rate of 15 cars daily.

Livingston.—The Vinegar Hill Zinc Co. has resumed output at the Dale mine after a shut-down lasting more than a year. A force of 50 men is at work. The crude-zinc concentrate is shipped to the National Separators, at Cuba City, where it is treated and reduced to high-grade blende. The sulphur is burned off and used in the manufacture of sulphuric acid.

Mineral Point.—Shipments of zinc oxide from the works of the Mineral Point Zinc Co. are steady. Demand is good.

Platteville.—Sales of high-grade electro-magnetic separator blende have been made for the first time in several months, and buyers representing the larger smelter concerns are in the market for ore. Local offerings for 60% zinc ore were made on a base price of $27 per ton, and some sales brought a top price of $30. Lead ore advanced in price steadily, the latest quotation being $60 per ton, base price, standard 80% assay. Premium-grade lead-concentrate obtained in wet concentration of zinc ore, as by-product, brought as high as $62.50 per ton. Sales were more liberal and prospect work was greatly accelerated at all points in the field, as a result of the higher offerings. A considerable tonnage of both high-grade zinc ore and milled lead ore was carried over by many of the active producers when the shut-down became general; these are now willing to sell in order to realize on their holdings sufficiently to resume operations. A demand has sprung up for repair-parts, renewals, and new mining machinery, and several properties are being equipped. Some new mill building has been contracted as well.

The Block-House Mining Co., which is operating the Schroeder mine and mill, is engaged in constructing a new mill on the Goke tract, one-fourth mile to the east. The two mines are on the same big east and west range.——Savage-Menke Mining Co., prospecting on the Dixon range west of this city has installed power, pumping, and milling machinery, and lead ore is being prepared for market.

BRITISH COLUMBIA

Barkerville.—A. Sanders has uncovered a 30-ft. belt of oxidized pyrite, on Proserpine mountain, that carries numerous quartz stringers. The oxide shows well in the pan, and samples have assayed from $380 to $450 per ton. At a depth of only a few feet the ore is solid sulphide. A trial shipment of the oxidized ore is to be made.

New Denver.—Thomas Avison and Ben Killsall, who have a lease on the Alpha mine dumps, have worked over the upper dump, concentrating the picked ore in a coarse jig, and have 45 tons of concentrate that is being hauled to Silverton for shipment to Trail.——Lessees at the Standard mine are drawing stope-fillings and breaking down good ore at isolated points in the mine. The flume is being repaired and the mill will be started shortly.

Prince Rupert.—The tramway connecting the Pugsley mine with the mill of the Surf Inlet Mines, Ltd., is now nearly completed. The Pugsley ore is of a much higher grade than the Surf Inlet ore, and operations should show a good profit in the future.——Eastern capitalists have bonded the Silver Bar group for $75,000 and the Waverley group for $30,000. Both groups are situated on the Kitsault river, in the Alice Arm district.

Stewart.—The case of Pat Daly v. R. K. Neill, in which the plaintiff claimed a one-fourth share in the Premier mine, valued at $1,960,000, has been settled out of court, Daly being contented to receive $15,000.

Victoria.—A deputation, consisting of J. J. Warren and T. W. Bingay, of the Consolidated M. & S. Co.; Valentine Quinn, of the Granby M. S. & P. Co.; S. S. Fowler, of the Bluebell mine; and G. P. Jones, of the Nickel Plate mine, waited on the Provincial government to request consideration of the method of assessing taxation in the mining industry, particularly with regard to a greater allowance for depletion, depreciation, and development.

The announcement is made that the zinc production of the Trail smelter of the Canadian Consolidated Mining & Smelting Co. this year will be the largest in the history of the plant. The output will be nearly 50% above that of last year. A market has been found in the Orient, important shipments having been made to the East recently, thus relieving the pressure of surplus stock. Improvement in copper-market conditions in British Columbia is also noted. A large concentrating plant is proposed for Anyox, the smelting centre of the Granby Consolidated Mining & Smelting Co. There is the new mill of the Britannia Mining & Smelting Co., Britannia Beach, as well as the proposed new mills at the Sunloch and Old Sport mines, Vancouver Island, to be constructed by the Consolidated Mining & Smelting Co., Ltd. Besides, there is no doubt that operations will be renewed on a substantial scale at the Copper Mountain mine, Princeton, while the Iron Mask at Kamloops and other properties now idle will become active.

MEXICO

Chihuahua.—The past week has witnessed a continuation of general activity in the mining industry. Each day additional mines are added to the list of shippers. Properties which have been idle for several years are being opened again and shipments are being resumed. All of the mining agencies report renewed activity in the way of new filings.

At the Chihuahua mining office, M. D. Murray has recorded the Watson group, comprising 78 contiguous claims situated in the Torreon district; also the Watson No. 1 group in the same vicinity, composed of 38 pertenencias. These properties are situated near the San Jose mines, which produce lead, silver, and copper.——At Ocampo, Enrique Diaz Duran has made application for titles to the Progreso group of 24 mining claims, in the Concheno district contiguous to the Veracruz and Orizaba mines.——At Ciudad Guerrero, Jose Moreno and Juan Molinar have recorded the San Andres, a promising prospect of 10 adjoining claims in the mountains about 10 miles north of Madera. In the same district J. R. Corral has located the Santo Nino mine, which carries gold, silver, and lead.——At Parral, Charles P. Holter has made application for titles to a group of 10 claims in the municipality of Zaragoza near the Santa Fe and La Estrella mines.

Durango.—Simultaneously with the resumption of operations at the Asarco smelter in the Velardeña district the producing mines which have been idle for the past year are again opening, not only in that immediate vicinity but throughout the whole State. Stimulated by the price of silver, it is reasonable to suppose that by the first of next January many silver mines will resume.

Nacozari.—William Jensen, who recently acquired title to the El Trigo mine in the Sahuaripa district, will complete a tunnel that will cut the ore below the level of the old workings. He plans to install a Pelton wheel and a five-stamp mill. The ore averages 3 oz. in gold. The tailing from amalgamation will be stored for tabling and cyaniding.

W. F. B. Berger, of New York City, is making a trip of inspection to the Lampazos mine, owned by the Bank of Sonora. This mine was worked until 1907, having produced two million ounces of silver. An estimate will be made of the cost of unwatering the mine for an examination.

J. W. Reynolds and M. L. Buckley, of Pilares, have

acquired several important claims adjoining the Zarape concession of the Moctezuma Copper Co. and have organized under the name of the Pilares Extension Mining Co. A tunnel is being run from the west end of the property to tap the old workings. Among the claims acquired are San Francisco de la Fortuna, La Mestiza, and San Francisco No. 2.

H. C. Carlisle and H. C. Beauchamp have just completed a trip of inspection through the Moctezuma district and have taken options on several properties; they have also located some good ground for denouncement later. Some of the properties optioned are the San Jose, owned by George Moore, the San Juan of Miguel Antunez, and the Exito in the El Tigre district.

ONTARIO

Cobalt.—There will be no general resumption of work this fall at the closed-down mines in the Cobalt district. Mine-owners believe it will be to their advantage to wait until next spring before re-opening the present idle mines. There are nine companies producing, these being the Nipissing, Mining Corporation, Coniagas, O'Brien, La Rose, Kerr Lake, Bailey, Hudson Bay, and Chambers-Ferland. Production is small and intermittent from the Kerr Lake and the Chambers-Ferland, while the Hudson Bay is carrying on milling operations in order to dispose of all the broken ore in sight, preparatory to definitely shutting down, due to exhaustion of the ore.

In the South Lorrain district, the Keeley is producing at a rate of about 120,000 oz. per month from a high-grade ore-shoot entered two months ago. It is probable that this record will not be maintained, and that within a few weeks the output will return to normal of about 60 tons of ore daily, containing an average of 30 oz. silver per ton.—— A mineralized body, containing $5 per ton in gold, is being explored in the Larder Lake district by the Crown Reserve Mining Company.

Kirkland Lake.—The property known as the Jerred claims, comprising 196 acres adjoining the King Kirkland, has been taken over on option by C. F. Jordan, president of the King Kirkland. Several promising gold-bearing veins are in evidence and exploration is in progress.

Development at the 900-ft. level of the Kirkland Lake mine has placed a considerable quantity of high-grade ore in sight. The mill is treating about 4000 tons of ore per month.

Matachewan.—At the Thesanus mine on the Montreal river, 20 ft. of ore stated to carry free gold has been opened in a cross-cut at the 100-ft. level.

Porcupine.—The Dome Mines during September produced nearly $250,000, the mill having operated at 90% capacity, treating over 30,000 tons of ore with a recovery approximating $8 per ton. This is the highest average mill-head so far obtained.

The management of the Hollinger Consolidated has decided to sink another big central shaft of at least six compartments to a depth of approximately three-quarters of a mile. There are now 1970 employees on the payroll and upward of 100 machines in operation underground, and an average of from 3800 to 4000 tons of ore is being taken out every 24 hours.

At the Premier Paymaster two large return-tubular boilers of about 150 hp. capacity have been installed, giving the necessary power to sink to the 800-ft. level. A large ore-body has been opened at the 200-ft. level and it is proposed to develop it at greater depth.

West Shining Tree.—Good results have been accomplished by development at the White Rock, where a vein has been traced on the surface for 2600 ft. A shaft has been sunk for 65 ft., at which depth the vein was tapped by cross-cutting. Being drifted upon it widened to 6 ft.; it is stated to carry $12 ore.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Owen Letcher has been touring India.

C. J. F. Galloway is on his way from Sarawak, Borneo, to England.

R. B. McGinnis, of San Francisco, has moved to Virginia City, Nevada.

George A. Camphuis has moved from Arivaca, Arizona, to Los Angeles.

Harold Borchsenius is with the Standard Oil Co., at Tupman, California.

Arthur W. Jenks is conducting mine examinations in Northern Ontario.

George Fischer has moved from Klamath Falls, Oregon, to Oakland, California.

W. A. Ray was married to Miss Minnie Rindfleisch, of Denver, on October 26.

R. C. Gemmell and **D. D. Moffat** have returned to Salt Lake City from Arizona.

Hector McRae, of St. Louis, Missouri, expects to go to London at the end of this month.

A. L. Reese, chief chemist to the United Verde Copper Co., at Clarkdale, Arizona, is in San Francisco.

D. M. Drumheller, Jr., has opened offices as consulting mining engineer in the Peyton building, Spokane.

W. F. Hayden, chief engineer for the Caribou Placer Co., near Soda Springs, Idaho, was at Salt Lake City recently.

Frank J. Morehouse, who is in charge of the Silver Reef Consolidated Mines Co. at St. George, Utah, is in New York.

W. H. Landers, recently of Charleston, West Virgina, is with the Clinchfield Products Corporation, at Erwin, Tennessee.

R. B. Lamb wishes to make public the fact that he is not associated with the promotion of the Gem Mining Co. of Colorado.

Mat. Sample, mine superintendent of the Chile Exploration Co. at Chuquicamata, is visiting mining districts of the West. He will return to Chile in December.

J. H. Saville, assistant manager for the Pyrites Co., at Wilmington, Delaware, sailed on the 'Olympic' on November 5 for Southampton. He expects to spend a few months in England and on the Continent.

Stephen L. Kaffer, who has been chief engineer for the past six years at the Phelps Dodge Corporation's Burro Mountain Branch property, is now in the sales department of the Mine & Smelter Supply Co. at El Paso, Texas.

Obituary

William Hatfield, a well-known mining man of Utah, died at his home in Salt Lake City on October 31. He was born in England 73 years ago, and came to Utah when a boy of 16. He was attracted to the mining business and is credited with being the first man to find ore in the Bullion-Beck and Swansea mines in the Tintic district. Later he operated the Snowflake mine in that district, and then became interested in the Alta district. He was one of the best-posted men in the State on Tintic and Alta mining properties, and at the time of his death was heavily interested in Tintic mines. He is survived by his widow, three daughters, and two sons.

THE METAL MARKET

METAL PRICES

San Francisco, November 7

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.50
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

November 7.—Copper is more active and stronger. Lead is quiet and firm. Zinc is more active and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 1	69.62	40.12	Sept. 26	67.68	40.96
" 2	70.25	40.50	Oct. 3	71.07	42.89
" 3	70.00	40.25	" 10	70.73	42.06
" 4	69.62	39.87	" 17	72.97	42.57
" 5	69.50	39.87	" 24	70.64	40.52
" 6 Sunday			" 31	70.04	40.25
" 7	67.75	39.00	Nov. 7	69.46	39.93

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.38	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.60	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Nov. 1	12.75	Sept. 26	12.12
" 2	12.75	Oct. 3	12.21
" 3	12.75	" 10	12.64
" 4	12.75	" 17	12.80
" 5	12.75	" 24	12.69
" 6 Sunday		" 31	12.68
" 7	12.75	Nov. 7	12.75

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 1	4.70	Sept. 26	4.68
" 2	4.70	Oct. 3	4.70
" 3	4.70	" 10	4.70
" 4	4.70	" 17	4.70
" 5	4.70	" 24	4.70
" 6 Sunday		" 31	4.70
" 7	4.70	Nov. 7	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Nov. 1	5.05	Sept. 26	4.73
" 2	5.10	Oct. 3	4.94
" 3	5.20	" 10	4.74
" 4	5.25	" 17	5.12
" 5	5.25	" 24	5.14
" 6 Sunday		" 31	5.07
" 7	5.25	Nov. 7	5.18

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Oct. 11	47.50	Oct. 25	42.50
" 18	47.50	Nov. 1	42.00
		" 7	40.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

THE REWARD OF THE COPPER PRODUCERS

What does the average man know about copper? Probably only that two small round pieces of it with a bust of Lincoln on one side and a few words on the other will buy a newspaper. Perhaps that it clutters up his pocket and gets in the way of his more important small change. Maybe even that it is used in making some kinds of wire, or, in this day, to make kettles suitable for home brewing. Unless he is connected in some way with the business of copper mining, manufacturing, or marketing it is unlikely that he knows much more about it than that. But there really is much more worth knowing, says the 'Chicago Tribune'.

For instance: In 1895 the production of copper was only 380,000,000 lb. Then the expansion of the electrical industry, and later the Spanish-American war, the Boer war, the Russo-Japanese war, and the Balkan wars rapidly increased the demand and output. Between 1895 and 1918 production jumped to 1,928,000,000 lb. per year. World war demands raised it to 2,500,000,000 lb. in 1918. New mines were opened and mining and refining processes improved. Early in 1919 there was 1,000,000,000 lb. surplus stored in the United States. At the beginning of 1920 it was worth 19 cents per pound. At the end of the year it was worth 12½ cents.

Business was bad. Thousands of miners were out of work. Millions of dollars worth of mines, smelters, and factories were idle and deteriorating. Did the men in charge of this bad business sit down and cry, or wail for Government help? They did not. Did they protest that they had been unfairly treated because while they were selling their product at high prices for war purposes substitutes had been invented for peace purposes, advertised and made popular in many fields where normally copper would have been used? They did not.

The copper industry started out to learn all the disadvantages and possibilities of the situation. It made a survey which took a year, and the results of which filled seven big volumes. It covered the copper and brass industry completely from 1895 to date. It got all available information on substitutes, uses, sales, advertising, etc. Then it organized the Copper and Brass Research Association to study better and cheaper ways of mining and refining, and learn more practical uses of copper. Now it is preparing to tell the world all the advantages of copper and brass for hinges, door-fittings, plumbing fixtures, cooking-utensils, roofing, gutter-pipes, screens, and a thousand and one things as yet unknown.

It will educate the public to use copper—to demand copper. It will make a market. It will prove to the buying public that copper goods of some kind are needed in every home and every business. When they have done, copper will be valued for a thousand uses where now it is valued for one. That will be good for the copper trade, the manufacturer, the sales agency, and the consumer. That is good business. That is the kind of fighters 1921 will reward.

MONEY AND EXCHANGE

Foreign quotations on November 7 are as follows:

Sterling, dollars:	Cable	3.94
	Demand	3.94½
Franc, cents:	Cable	7.43
	Demand	7.45
Lira, cents:	Demand	4.26
Mark, cents:		0.40

Eastern Metal Market

New York, November 2.

A fairly optimistic tone pervades all the markets; it is more prominent in some than in others.

Demand for copper is again better and sales have been fair.

The tin market is quiet but firm and steady.

Buying of lead is moderate; the price shows no signs of change.

Zinc is the weakest market; demand has subsided.

Antimony continues to decline.

IRON AND STEEL

New buying has been light the past week, but several steel companies found bookings in October better than in any other month this year, made up largely of light products such as pipe, sheets, etc.

Pig-iron production in October increased beyond expectations, being the largest since March and representing a gain of 43% upon the low figure of July. As wired to 'The Iron Age' from all districts on November 1, the returns make a total of 1,240,162 tons, or 40,005 tons per day, against 985,529 tons in September, or 32,850 tons per day. The increase over September is about 22%. Seventeen furnaces blew-in and three blew-out in October, a net gain of 14; the 96 furnaces in blast on November 1 had an estimated capacity of 43,500 tons per day, as against 35,650 tons per day for 82 furnaces one month previous.

COPPER

For a few days last week it was possible to buy electrolytic copper in limited quantities at 12.62½c., New York, or 12.87½c., delivered, but this has disappeared, and it is believed that nothing less than 13c., delivered, can now be done. At the latter price considerable business amounting to a fairly large tonnage, is reported to have been done late last week and early this week; one seller reports that inquiries are larger than in a long time. The feeling prevails that a steady business is to develop in the near future and that the market is in for a season of healthy but not spectacular business. Sales for the month of October are estimated at not less than 60,000,000 lb. and export business is calculated to have been less than in September.

TIN

The past week has been one of the most inactive for a long time. One explanation is the fact that because of the threatened railroad strike, consumers of Straits tin not only bought fairly freely for spot delivery but accumulated supplies from warehouses. This has eliminated the spot demand for the present. There has been a little business in future shipment from the Far East, but less than in some weeks. October statistics show that deliveries into consumption were 2280 tons, with 1319 tons in stocks and 650 tons landing on October 31. Spot Straits tin was quoted yesterday at 28c., New York, or ½c. under that of a week ago. Strength in sterling has been a factor in maintaining quotation at 28 to 28.50c. London prices are steady, or only £1 per ton under those a week ago, with yesterday's quotations at £155 10s. for spot standard, £157 15s. for future standard, and £156 for spot Straits.

LEAD

This market continues its steady course, devoid of features but characterized by a fairly steady demand which absorbs available supplies fairly promptly. Quotations are unchanged, that of the leading interest standing at 4.70c., both New York and St. Louis, while in the outside market they are 4.70c., New York, and 4.40 to 4.45c., St. Louis.

ZINC

A marked lull in demand is reported; and, as a consequence, a softening in prices. While the railroad strike threat was in the air and before, demand from galvanizers was brisk, but they evidently covered their needs, at least for the early future. Evidently prime western can be bought as low as 4.55c., St. Louis, or 5.05c., New York, for early delivery, but it is stated that only second-hands will entertain orders at this level, practically all producers adhering to a minimum of 4.60c. or even higher.

ANTIMONY

There has been a further easing in values until the metal is now available at 4.75c., New York, duty paid, for November delivery, with spot held at 4.80c. and jobbing lots about ¼c. higher.

ALUMINUM

Although the leading interest continues to quote virgin aluminum at 24.50c., f.o.b. plant, it is reported that it is willing to meet or has met importers' quotations of 17 to 18c. per pound, New York, duty paid. Rumors of large sales recently have not been confirmed.

ORES

Tungsten: Conditions are unchanged and quotations nominal in an inactive market at $2.50 per unit and higher, depending on the grade, delivery, etc.

Molybdenum: The market is devoid of activity or feature, with quotations nominally unchanged at 50c. per pound of molybdenum sulphide in regular concentrates.

Manganese: There is an entire absence of business and quotations are still nominal at 20c. per unit, Atlantic seaboard, for high-grade foreign ore.

Chrome: No demand is reported and hence quotations are nominal at $20 to $26 per net ton, c.i.f. Atlantic ports for foreign ores, standard quality, depending on analysis.

FERRO-ALLOYS

Ferro-manganese: No demand at all is reported by British or American sellers, who still quote on a basis of $58.35, seaboard, for either alloy. Production in the United States in October was 3902 gross tons.

Spiegeleisen: A sale of 200 tons is reported at about $25 to $26 furnace. Aside from this the market is featureless.

Ferro-tungsten: Quotations are nominal at 40 to 45c. per pound of contained tungsten for the domestic alloy, with the foreign quoted at 50c., duty paid, seaboard.

Ferro-silicon: A moderate activity is noted at ruling prices of $55 to $57, delivered. Some sellers quote $60, delivered, as a minimum.

Ferro-chromium: Regular standard alloy, 4 to 6% carbon and 60 to 70% chromium, is obtainable as low as 10 to 11c. per pound of contained chromium from domestic producers.

An investigation of the electrothermic smelting of zinc and the condensation of zinc vapor is being undertaken at the Mississippi Valley Experiment Station of the U. S. Bureau of Mines at Rolla, Missouri, in co-operation with the Missouri School of Mines and Metallurgy. A critical study of the physics and chemistry of the condensation of zinc vapor will be made for the purpose of obtaining sufficient data to design a condenser for an electric furnace which will result in the elimination or diminution of the formation of blue powder. The investigation will be made by B. M. O'Harra, assistant metallurgist, William Kahlbaum, co-operative chemist, and Clarence W. Burkhart, fellow in electrometallurgy, the work being under the general supervision of D. A. Lyon, chief of the metallurgical division of Bureau.

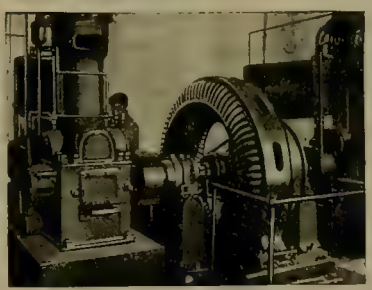
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE SULLIVAN MACHINERY CO.'S MOVING PICTURE OF ROCK-DRILL PRACTICE

A feature of the machinery exhibit, in the Chicago Coliseum, in connection with the recent meeting of the Mining Congress was the four-reel moving-picture film exhibited by the Sullivan Machinery Co. The purpose of the film is to show as many phases of work with rock-drills as possible. The result is an entertaining as well as an instructive 'show' for which the Sullivan company has reason to feel proud. The accompanying illustrations give some idea of the character of the pictures. The four sections of the film deal with the following phases of rock-drill work.

1. Pictures taken at Mineville, New York, and at Hurley, Wisconsin, showing the use of hammer- and rock-drills in shaft-sinking, heavy drifting, stoping, block-holing, etc. A feature is the shaft picture taken 1700 ft. underground, said to be the greatest depth at which a moving picture has ever been secured.



Typical Views from the Sullivan Company's Moving-Picture 'Show'

2. Stone-quarrying: Pictures taken at Westerly, Rhode Island, in the granite quarries and stone-cutting sheds, illustrate the use of heavy piston-drills mounted on tripods and quarry-bars; of plug-drills for splitting the blocks of granite; of 'steam splitting' of compressed-air drilling; and surfacing and carving tools in the granite-sheds.

3. Excavating rock on construction work: Pictures taken at Niagara Falls, Canada, on the ten-mile power-canal of the Hydro Electric Power Commission of Ontario, now almost completed. This reel shows remarkable pictures of channeling, tripod-drilling, submarine-type drills, rotator drills, steam-shovel work, concreting, and floating-dredge excavations.

(4) Drill-steel heating and forging: Illustrates the use of oil-forges with magnetic and pyrometer-heat control, and of compressed-air drill-sharpeners for forging drill bits and shanks. Pictures were taken at Ironwood, Michigan. The picture is noteworthy for the variety of scenes shown, all of which are actually taken in the field, and not in the factory or shop.

PACIFIC COAST DIVISION OF HYATT ROLLER BEARING CO. IS ESTABLISHED IN SAN FRANCISCO

The district office of the Hyatt Roller Bearing Co., at 74 New Montgomery St., San Francisco, has become the Pacific Coast Division; and unlike the other Hyatt organizations, the 'baby division' incorporates all three fields, namely, motor, tractor, and industrial. It is under the capable management of A. W. Fisher.

Mr. Fisher decided that in order to render real Hyatt service to the many coast industries, he required the services of another Hyatt experienced man, and accordingly the home office elected to send him a man thoroughly trained in Hyatt industrial applications, through several years of close association with the big industries of the East. George L. Thom, therefore, has promptly proceeded to sell himself on California and all the Pacific Coast.

Another change in Mr. Fisher's organization was effected when Philip Overman was transferred to Minneapolis. He was succeeded by 'Chip' Nagle, who looked after the mechanical inspection and experimental engineering at one of Uncle Sam's flying-fields during the War. Mr. Nagle is in the same capacity with Hyatt. The services of the Pacific Coast Division engineers are cordially extended to all those within its territory.

NEW ROLL-CAPACITY TABLES

Anyone who has ever tried to figure roll-capacity from the complicated diagram-charts usually employed will appreciate the new and original tables of roll-capacities contained in the C. G. Buchanan Co.'s new Bulletin 13, on Type 'C' crushing-rolls. These tables are very simple and easily understood. By their use any operator can quickly determine the size, speed, and number of rolls to be used for accomplishing a given amount of work.

Among the general data also included in this new Buchanan bulletin is a brief history of the origin and first introduction of rolls. The data given on the large capacity and the comparatively small amount of power required to operate these early and imperfect machines will be of keen interest to anyone who is not thoroughly familiar with the

use or possibilities of rolls as a crushing device for medium-fine crushing. The work accomplished by the pioneers in the use of rolls renders it unnecessary to make extravagant claims for present-day roll-performance.

The limitations of rolls are also clearly shown, particularly in regard to sizes of pieces that rolls can economically handle and the reduction that can be made in a single pass.

NEW SIGNAL DEVICES FOR INDUSTRIAL PLANTS

The Klaxon Co., for years well-known maker of automobile horns, is now turning its endeavors to the manufacture of industrial and mining signals. The Western sales agency for the company's products has been secured by E. D. Bullard, 268 Market St., San Francisco. One of the devices is the Klaxon industrial horn, which is an improved

Klaxon Horn for Industrial Use

automobile horn, changed in design to fit industrial purposes. Another is a single-stroke bell. There have been great calls for these, and the Klaxon Co. has made a positive-contact single-stroke bell by which code-calls can be sent, as each contact gives but a single stroke to the bell. In order to make its horns and bells even more useful, the company has added the 'Klaxocator', an instrument by which automatically any blasts on horns or strokes of bells can be sent to as many different stations as desired. In this way executives can be called, or alarms or time-signals can be sent out from one central station and a code-call repeated in numerous places around the plant.

COMMERCIAL PARAGRAPHS

Lynch Brothers, diamond-drill contractors, have announced the removal of their offices from 624 Alaska Bdg. to 219 Pioneer Bdg., at Seattle, Washington.

E. E. Aldous has been appointed representative for the **American Steel & Wire Co.** in St. Paul-Minneapolis-Duluth territory. Mr. Aldous, whose headquarters will be at St. Paul, has been connected with the company for 20 years in different positions and, therefore, is well posted in the different lines handled.

Bulletin No. 234, entitled 'The Continuous Heat-Treatment of Metals with Automatic and Semi-Automatic Furnaces', is the fourth of the series, published by the **W. S. Rockwell Co.**, dealing with fundamentals that influence the quality and cost of heated products. This bulletin illustrates practical applications of the principles outlined by the previous bulletins of this series—No. 230, 231, and 232.

J. C. Townley, formerly district manager of the Pittsburgh office of the **Cement-Gun Co.**, sailed for Holland on October 15, where he will take up his duties as general manager of the International Cement-Gun Co. The International Cement-Gun Co. has been recently organized to handle the foreign business for the Cement-Gun Co., with the exception of Canada, Mexico, and Cuba. The address of the company is 50 Maria Plaats, Utrecht, Holland.

The Powdered Coal Engineering & Equipment Co. moved its office and manufacturing plant from Chicago to Buffalo, New York, on November 1. The personnel of the organization has been somewhat changed, and H. B. Pruden has been elected as chairman of the board and J. W. Lansing of Buffalo has been elected president. The new board of directors of the company is as follows: J. W. Lansing, Fenton M. Parke, J. E. Finley, Harry R. Wait, J. C. Trefts, H. B. Pruden, B. W. Wistar, W. M. Faber, and Stephen T. Lockwood.

The Universal Crane Co. announces that George L. Sawyer has been appointed to represent it in the New York field in the sale of Universal cranes. His offices are at Allied Machinery Center, 141 Center St. Keen interest in the Universal crane has been shown throughout the territory due to the crane's adaptability to so many types of mountings and its great flexibility and economy in almost all material-handling fields. The big time-saving feature of this crane is its ability to be mounted on motor-trucks and trailers on which it can be moved from place to place several times as fast as other full-revolving cranes.

The primary function of a reflecting device or globe is to direct, diffuse, or modify the light given off by an incandescent lamp in such a manner as to make it more useful. Light from a bare incandescent lamp is given off approximately equally in all directions; therefore, to direct this light to certain areas some accessory is necessary. To serve this purpose, many types of reflectors find application, depending upon the particular use to which the lamp is put. An interesting discussion of the principles involved in obtaining efficient lighting by means of reflectors may be found in Bulletin LD-123, recently issued by the Edison Lamp Works of the **General Electric Company.**

The Stamp Electric Hoist Co., established in San Francisco during the early part of this year, is manufacturing electric hoists in lifting-capacities of from 500 lb. to 15,000 lb., the types ranging from the stationary hoist to the electric-driven cab-operated mono-rail system. A feature is their simplicity and accessibility. Inquiries for hoists should contain as nearly as possible the following information: (1) Kind of current. If alternating, state voltage, phase, and cycles. If direct, state voltage. (2) Capacity. State about what usual loads will be handled; also the heaviest load. (3) Type. Suspension, plain, or geared trolley, motor-driven trolley, floor, or cab-controlled. (4) Height of lift required. (5) Speed of lift required. (6) Kind of service to be performed. (7) Single or variable speed-control. (8) Outdoor or indoor service. (9) If trolley-hoist, state size of I-beam on which trolley is run.

'Dry-Vacuum Pumps' is the title of a recent bulletin published by the **Chicago Pneumatic Tool Co.** It presents a line of dry-vacuum pumps in which several new features of design are incorporated. In their design and construction the purpose throughout has been to produce pumps for duty where unquestionable dependability and sustained operating economy under exacting service conditions are paramount considerations. All that the finest materials and the most modern engineering facilities and practice can contribute toward the construction of a vacuum pump will be found in these machines. Through the elimination of inlet valves, as well as through the use of the efficient 'Simplate' discharge valve, clearanc has been minimized; hence the volumetric efficiency has been increased to such an extent that a vacuum within one-half inch of the barometer may be obtained. A further advantage of the new design lies in its simplicity, with consequent ease of operation, long life, and small number of parts to get out of adjustment. For service where only high vacua (22 in. of mercury up) are desired, pumps of the new design, without inlet valves, are recommended for the highest operating efficiency. For installations where low as well as high vacua are required, Chicago Pneumatic dry-vacuum pumps are equipped with 'Simplate' inlet valves.

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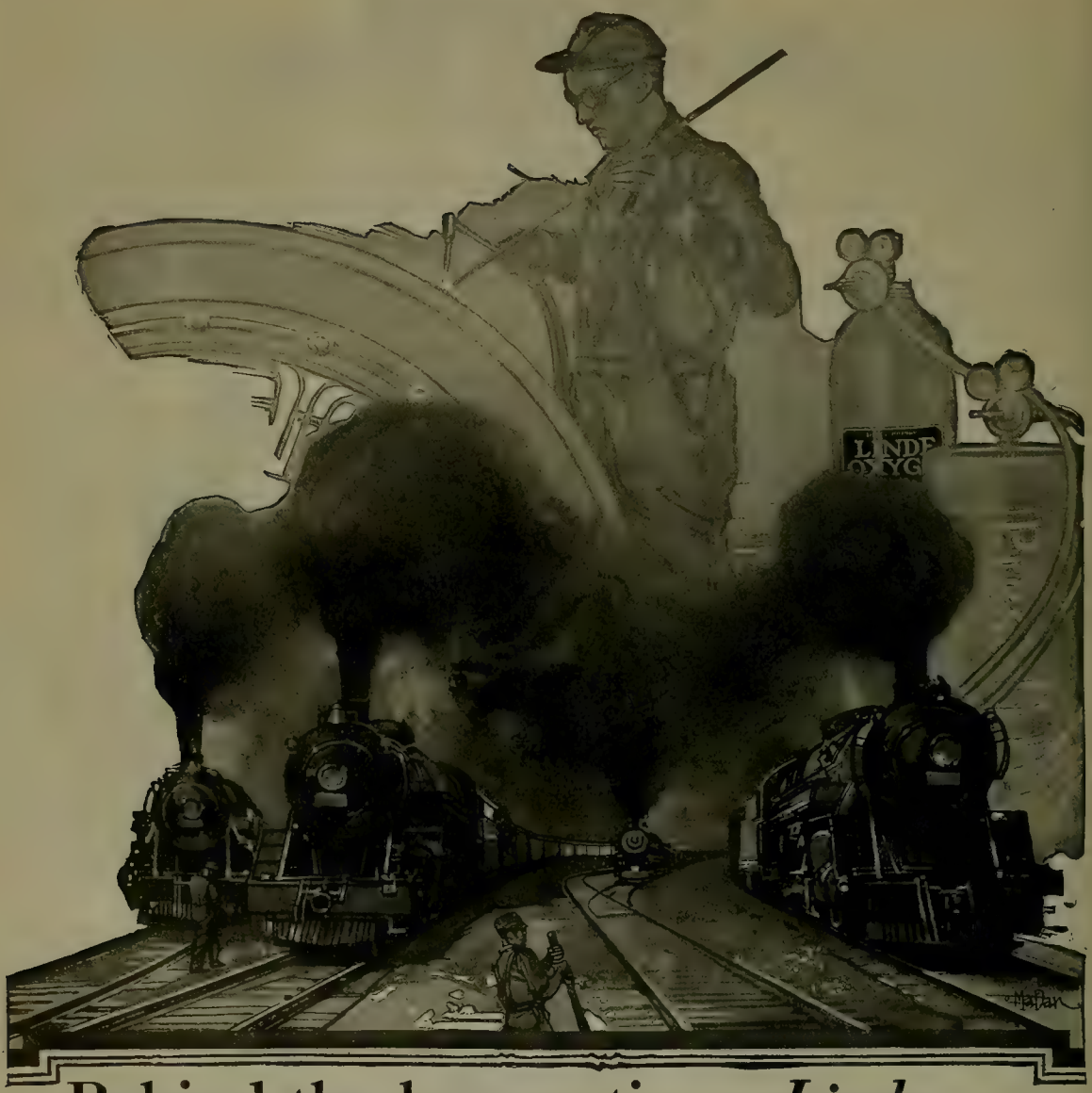

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T. A. RICKARD, - - - - Editor

IN our issue of August 20 we discussed the labor troubles at Grass Valley and the proposed arbitration. The latter was not put into effect, for reasons we suggested at that time, but on November 12 an agreement between the operators and the mine-workers was signed whereby $4.25 is paid to machine-men and $3.78 to shovelers, with extra pay for special work and for over-time.

REDUCTION in freight-rates, recently announced by the Southern Pacific Company and by other important transportation systems, will be welcomed as a significant move toward the re-establishment of normal conditions. A large item of the cost of delivered mining equipment, which is often exceedingly heavy, is the freight-charge. The reduction in rates for transportation will serve to encourage an early resumption of work in many mines, and will act as an incentive to increased activity in others.

COPPER statistics continue to improve. The sales of refined metal in October as compiled by the American Bureau of Metal Statistics show an aggregate of 140 million pounds, as against 97 millions in September, and an average of 75 millions in July and August. The October sales contrast cheerfully with a combined American output and import total of about 50 million pounds. A premature statement that the Inspiration Consolidated Copper Company was about to resume operations has been denied, but similar rumors may be expected henceforward, and it may not be long before an actual resumption of our big mines becomes a fact.

AMERICA can compete successfully with Germany for the trade in electrical machinery for South America. On the other hand, Germany seems determined to win back her position as a supplier of cheap ironwork. Bids were submitted recently to the Ministry of Public Works in Buenos Aires for a highway bridge over the Rio Segundo, in the Province of Córdova. The six lowest bids were from Germany, then one from Belgium, then three more from Germany, and lastly one from Belgium. No American or British bids were made, a consular report stating that the lowest price that any American firm was prepared to mention would have been over three times the lowest German bid. On the other hand, the recent acceptance of the bid of the Westinghouse Electric International Company, for the machinery needed for the electrification of the Chilean State railway between Valparaiso and Santiago, draws attention to the fact that a strong German combination was underbid to the tune of about $4,000,000. Thus it seems that American-made goods that contain a considerable amount of copper, in spite of high labor cost, are maintaining a hold on the markets of the world.

ULTIMATE revival of gold mining in Victoria, Australia, as well as in other States of the Commonwealth, is predicted by Mr. E. C. Dyason, the president of the Victoria Chamber of Mines. Australian gold mining, at the present time, is likened by him to "a patient that was being kept alive by the precarious oxygen of the gold premium"; the cessation of operations in Victoria, he affirms, will be due to economic and not to geologic causes, for few of the goldfields of that State have been exhausted of their reserves of 'ore'. This condition is similar to that which exists in many other parts of the world. The exploitation of low-grade copper ore would have been impossible but for improvements in metallurgic practice and the adoption of large-scale methods of mining and treatment. The gold-mining industry is passing through a similar phase of existence.

INVESTIGATIONS that should prove of value to the mining industry are being conducted at the Forest Products Laboratory at Madison, Wisconsin, on the preservation of timber used underground. A study of the problem has indicated that much unnecessary expense may be avoided by proper storage. Lumber yards should be on well-drained ground, free from debris and weeds. A proper foundation for a lumber pile is essential; adequate ventilation should be ensured by proper stacking. Investigations have been made to determine the value of treatment with various preservatives, to demonstrate the difference between harmless molds and wood-destroying fungi, and to estimate the worth of charring in the preservation of wood. A brief paper on the subject, by Mr. R. R. Hornor, of the U. S. Bureau of Mines, and Mr. G. M. Hunt, of the Forest Products Laboratory, has been prepared. In this the authors discuss the vitiation of air in mines by decaying timbers, the hazard of fire, and the extension of the life of timber by preliminary peeling.

Coal-tar creosote and zinc chloride are quoted as standard preservatives, application by pressure being recommended. Examples are given of results obtained by preliminary treatment. In one case, where untreated timber lasted but two years, treated timbers have been in service for 14 years and are still in sound condition; the treatment added but 10 to 15% to the cost, and increased the life of the wood by 600%. Treated mine-timber can be expected to withstand decay for from 12 to 20 years. The subject has been neglected by those in charge of many small properties. The work being done by the Forest Products Laboratory officials, in conjunction with Bureau of Mines engineers, is for the benefit of the mining industry, and operators should avail themselves of the results.

RESULTS and achievement can be judged only after due consideration has been paid to the question of time taken to carry out the work. Mr. W. F. Dietrich, who is Associate Professor of Mining at Leland Stanford University, contributes in this issue an interesting and educative article on time studies in metallurgical analysis, which should stimulate thought and should encourage imitative action elsewhere. It is pointed out that during the time spent in American universities, and we believe in those of many other countries also, the student is not encouraged to appreciate the value of a high standard of efficiency in personal action, or to avoid a wastage of time when he is supposedly at work. It has been estimated that the time required by different students for a single assignment may vary from half an hour to eight hours. Judgment as to merit is based on quality and quantity of work submitted, and no regard is paid to the factor of time. Thus, as Mr. Dietrich points out, many graduates enter industry handicapped by the circumstance that they have no idea of the proper connection between the performance of a task and the time taken to perform it. Thoroughness and accuracy are essential, of course; but results have shown that both are helped rather than hindered by an appreciation of the need for economy of movement and the systematization of action in individual effort.

IN this issue Mr. Albion S. Howe contributes to the general discussion of the proposed new mining law, emphasizing the difficulty that is experienced by prospectors and others who wish to know whether or not mineral land is open for location. If anyone is willing to prospect, he asks, why demand a discovery? The Central and South Eureka mines at Sutter Creek, California, for example, have a surface covering of gravel, of from 50 to 150 feet; ore in place could not have been discovered at the surface. The Central was located as a lode claim, and the South Eureka was patented as agricultural land, good for fruit and grain on the surface and for the exploitation of the Mother Lode gold deposits underneath. Other examples might be cited. Mr. Howe's view is supported by nine prospectors, whose letter on the same subject follows, and who register an emphatic protest against the proposed law, stating that they consider that its passage would result in the stoppage of prospecting and the extinction of the prospector. Incidentally we note that the committee on mining of the Commercial Club of Salt Lake City opposes the bill; this may be accepted as indicating the prevailing sentiment in Utah. Our Mr. Allen comments on the solubility of gold in mercury and the wetting of a sulphide by oil. Mr. A. W. Fahrenwald discusses several interesting points that were brought out in a recent article in our columns by Mr. Frederick G. Moses. He maintains that, in modern froth-flotation operations, all the particles of ore in a pulp are wetted with water before the oil is added; and that, when the oil is added, the water on the surface of the mineral particles is displaced by the oil, whereas other particles remain wetted with water. Mr. Fernando Benitez writes from Chile on the status of the natural nitrate industry. Mr. Alfred T. Fry writes from distant Tasmania and describes a simple scheme for comparing the mechanical efficiency of flotation-machine impellers and for obtaining other useful information.

The Washington Conference

The third anniversary of the Armistice was celebrated in diverse ways, suggesting the mental attitude of divers persons. Some saw in the day merely the date on which the War ended, so they assembled at dinner parties and dances; others accepted the President's proclamation as the fixing of a holiday, so they went to football matches; others used the opportunity to play golf. To none of these did the day mean anything in particular. To the more thoughtful the public burial of the unknown soldier afforded a chance for a local ceremonial at which the thousands of the unreturning dead were duly honored. At Washington itself the President and his administration represented the American people worthily by paying respectful tribute to the typical hero of the War; and the President himself, standing in a soldiers' cemetery, confessed the failure of a civilization that leaves its problems to the arbitrament of wholesale murder, and voiced the hope that the awakened conscience of the world would make itself heard in the councils of the nations. The ceremony on Friday was a fitting prelude to the opening of the Conference on Saturday. There again the President spoke for our people when he said that they "want less of armament and none of war". He spoke for "a war-wearied world, struggling for restoration, hungering and thirsting for better relationship; crying for relief and craving assurance of lasting peace". His speech of welcome to the delegates was followed immediately by a frank proposal, made through the Secretary of State, for a temporary cessation of naval construction on the part of the three principal maritime powers. The proposal was made in a manner that augurs well for beneficent results. To Mr. Harding and his associates has been given an extraordinary opportunity to perform a service to humanity that will make them honored for all time; to the United States is accorded an oppor-

tunity to achieve "that nobler thing which no nation can do alone". It is a great occasion, and the representatives of our republic have risen to it finely. Even the meaner part of the daily press has felt the urge of public opinion and is giving serious consideration to the Conference. Our hopes and prayers are with the statesmen at Washington; the whole world stands on the tiptoe of anxious expectation. The confidence of the public, however, is disciplined by the remembrance of the bitter disillusionment that followed the Treaty of Paris. The contrast between the brave promises and the ignoble performance of that conference is still in our minds; and, if we hope for better results now, it is largely because we believe that the atmosphere of public opinion is more favorable to a fruitful outcome; the peoples of the earth are sadder and wiser, they are better informed and less visionary than they were three years ago; humanity at large is sick and tired of war and the fruits of war; they know those fruits to be bitter to the taste, even in the mouth of the victor; they look to their leaders to make an end of a hateful system and intend to hold them to account if they fail to accomplish the salutary purpose for which they have been sent to Washington at this time. They must disarm their minds of the prejudices that wrecked the Paris conference, and we, of the public, must do likewise, if anything lastingly useful is to be accomplished. For the American people, as for others, it is necessary to consider how much of independence it shall forego in order to recognize the interdependence of all the peoples. As the individual surrendered some of his freedom for the sake of community life, so each nation must yield some of its sovereignty in order that the life of the world as a whole may be sustained and bettered. If conscience and sentiment fail in arousing general sympathy with the peacemakers, it seems likely that the pocket-nerve may awaken the self-interest of the citizen in every country. As Lord Morley has said, the tax-collector is the true school-master; he has been teaching us how appalling is the cost of war, and how great is the burden it is imposing both upon the wealth and the manhood of all the nations. Armament and other preparations for war mean the support of masses of non-productive men by those who are engaged in productive industry; it is a tax that humanity must refuse to pay, for economic reasons alone, wholly apart from the nobler sentiment that recoils from the spectacle of the scientific killing of the flower of the race. The cost of a battleship represents a sum equal to the endowment of a university; the battleship 'California' cost more than Stanford university. At this moment millions are starving and the channels of industry are clogged by the ruins of war; the structure of human society is in danger of disintegration and a few wrong-headed men continue to arouse the snarling instincts that man inherited from the jungle. It is high time to call a halt, to take stock of ourselves as inhabitants of an unhappy planet, to prevent the suicide of our civilization, and to resolve to do our very utmost to promote the consummation of "that far-off divine event to which the whole creation moves".

The Missouri School of Mines

Most of our readers will be surprised to learn that the State of Missouri has a School of Mines old enough to be able to celebrate its semicentenary; yet such is the case, and on November 5 this fiftieth anniversary was celebrated in proper style. The School constitutes a part of the University of Missouri, but it is established at Rolla, whereas the University itself is at Columbia. The little agricultural settlement of Rolla is situated in the Ozark region and is well placed in respect of the mining districts of the State. The buildings and equipment of the School are well adapted to their essential purpose; the faculty has won the respect and regard of both past and present students; the institution has achieved a distinct place among the educational establishments of the country. At the present time 586 students are in attendance, but, of these, 162 are non-collegiate men who are receiving a vocational training in topographic surveying and highway work—ex-soldiers to whom a new start in life is being given. The graduating class numbers 160. A School of Mines such as this is known by its graduates, as a tree by its fruit. The 'M. S. M.' has sent forth many good men, among whom we venture to mention Messrs. D. C. Jackling, John W. Pack, W. Rowland Cox, Preston K. Horner, Herbert R. Hanley, and W. W. Wishon among those whom we happen to know as successful mining engineers and metallurgists. Mr. Jackling's pre-eminence is readily acknowledged by his fellow alumni, and it is fair to say that a mining school that trained a boy to become such a captain of industry has fully justified its existence. The semicentenary was celebrated by a football match, an alumni banquet, a meeting of the St. Louis section of the Institute, the organization of an Alumni Association, and an address by a representative of the mining industry. The event brought men from distant parts; for example, Mr. J. K. Walsh, of the class of '17, came from Cerro de Pasco. The various speakers expressed affection for their Alma Mater by happy allusions, and recorded their goodwill toward members of the faculty, among whom Mr. George R. Dean, Professor of Mathematics, was specially honored; indeed he seems to play the part at Rolla that Van Amringe does in the traditions of the Columbia School of Mines. Repeated references were made to the pleasant relations that have been maintained between the School and the townspeople, and several local citizens received friendly mention on the part of old students. Two of the former Directors of the School, Messrs. L. E. Young and A. L. McRae, were present and spoke felicitously. The present Director, Mr. Charles H. Fulton, a Columbia graduate, holds the respect of faculty and students alike; he is an earnest man and is imbued with broad ideas, so that the future of the School is in safe hands. Mr. Arthur D. Terrell was toastmaster at the banquet and was chosen as president of the Alumni Association, which was organized at the close of the dinner. The starting of this fraternal union was the most important event of the celebration, for it will serve to sustain the personal interest

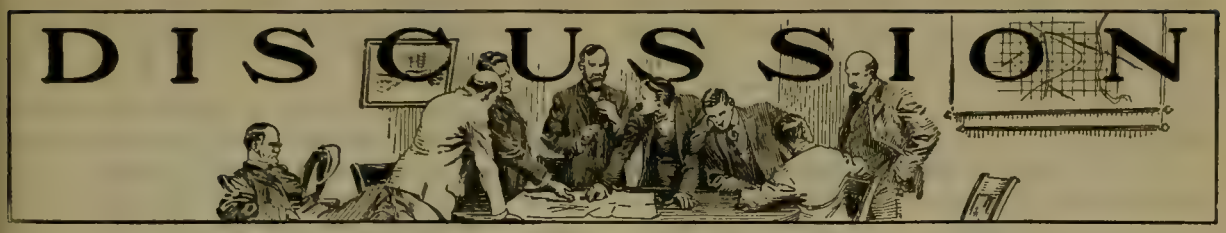
of the widely scattered alumni in their Alma Mater; it will create a body that can speak for the best interests of the School; and it will serve to crystallize the traditions upon which the higher spirit of such an institution lives. The Missouri School of Mines has made good; we wish it continued success and prosperity.

Mechanical Shoveling Underground

In this issue we publish a timely and informative article on the 'Use of Scrapers Underground'. For this we are indebted to Mr. Lucien Eaton, mine superintendent for the Cleveland-Cliffs Iron Company in the Ishpeming district of Michigan. Incidentally, we compliment Mr. Eaton on the evident care taken in the preparation of this article, which, in many respects, is a model of technical writing. The subject is one that is engaging the attention of most managers of mines, as is indicated by the replies received in response to our recent interrogatory on conditions in the industry. One of the questions in this catechism asked "What class of machinery is least satisfactory in the performance of its function?" The manager of a gold mine answered succintly, if somewhat whimsically, "The shovel". He had in mind the familiar No. 2 with a hickory handle and a steel blade. In mines where some system of caving or shrinkage-stoping is not used, it is probable that, until a few years ago, much more than half of the labor underground was expended in getting ore from the face, where it was broken, into a car on a haulage-level, or into a chute from which it might be loaded into such a car readily. This is the work known as 'mucking'. The man who does it may have a small car, or a bucket on a truck, which he loads and pushes to a chute or to a larger car, and dumps it; a wheelbarrow may be substituted for the car, in which event he does not need to lift the ore so high. If he is working in a drift on the main level he probably loads a larger car and must lift the ore still higher. But under any and all circumstances he works with a shovel; the shovel is to him as the trowel is to the mason, or the needle to the tailor. There is an art about using a shovel; a good shoveler can load twice as many cars as a poor one, and tire himself not nearly so much. Ore is hard and heavy; large pieces are mixed with small; the filling of the shovel is difficult; the raising of it, loaded, is a strain; and, if the ore has to be thrown or carried, more arduous effort must be expended. The toil of a shoveler who makes a 'good showing' for his shift's work is heartbreaking, as only those who have done it know. But, disregarding the human element, under most circumstances shoveling by hand is deplorably inefficient from the cold-blooded standpoint of dollars and cents. If the shoveler fail to do a reasonable day's work the net efficiency is diminished in proportion. It seems astonishing that effort was not directed 30 years ago toward development of devices for applying mechanical power to the work of loading ore underground. Coal-mine operators were the first to make use of mechanical loaders, but in the last decade rapid progress has been made in developing machines to meet the requirements of metal mines, and in introducing them underground. This may be accounted for largely by the prevailing high wages, by a growing tendency of employees to take things easy, and, during the War, by a shortage of men. The results of the first two were reflected in the cost-sheets; of the last, in the production record. The only remedy was the development of devices and the utilization of mechanical power that would enable a given number of men to move more ore than they had been moving, and with less physical labor.

There are manufactured today several machines costing from $3000 to $10,000 that are satisfactorily loading broken rock in large adits or tunnels. Although not perfect, several of these machines have a large capacity; they are reasonably rugged and mechanically efficient; but they are bulky and costly and are accordingly most suitable for work in large headings and on long jobs. In general there are two types of machine; those of the first type operate on the principle of a steam-shovel; they consist of a dipper that digs into the ore, obtains its load, swings around, and dumps directly into a car. Those of the second type may be likened to a dredge, in that the bucket or buckets travel on an endless belt or chain and discharge onto a conveyor that in turn carries the rock to the car. Numerous ingenious machines have been built embodying these broad principles. For the ordinary work in most metal mines, however, these machines are too costly, too cumbersome to transfer from place to place, and too dependent upon the attention of an expert mechanic. The impracticability of using such a machine in the average stope is obvious, although an exception must be made of the mining of horizontal bedded deposits having large area. Under such circumstances the advantages of a mechanical shoveler may be sufficient to warrant its use.

As an alternative to the complicated mechanical loader, the steel scraper operated by means of wire-rope lines actuated by a small air- or electric hoist has come into general use during the past five years. Mr. Eaton's article describes the various types of scrapers; it discusses the principles of their design and the methods of using them, the field for which they are most suitable, and their limitations. He remarks that the technique of operation has not been perfected, by any means, and invites an exchange of views on the subject. The ideal 'shoveler' is a fool-proof machine, of reasonable price, that will handle both coarse and fine material; that is light enough to be moved about from one drift to another or from one part of a stope to another; that will operate efficiently in an ordinary drift; and that, in addition, will do the work rapidly. This is a large order; it is improbable that any one machine will be built to fulfil all these requirements, but it is not improbable that, before many years, the inefficient drudgery of shoveling by hand will join the arts of single-jacking, and of sharpening drill-steel with a two-pound hammer on the old anvil, as relics of a forgotten past.



Mining Law Revision

The Editor:

Sir—In the discussion of the proposed mining law revision, I agree entirely with Robert B. Brinsmade in his article in your issue of October 8. The Government should retain ownership of its valuable minerals for the use of future generations. There is no better mining law than that of Mexico, where the surface rights are separate from the mineral rights and where any prospector can easily learn whether or not a prospect is open for location.

In your paper, not long ago, you were inviting discussion as to why there are not more prospectors, and why they do not prospect and find undeveloped ore deposits. The principal reason is because there is so much patented land that is not open to location. After a few years the stakes or monuments disappear, and no one can tell, without a survey, whether or not he can enter and make a location that will hold. Much mineral land has been taken and patented as agricultural land, and such applications for patent are continually before the General Land Office. When land is once patented before mineral discovery, there is not one chance in a thousand of anyone attempting to develop a mine therein. The rancher will not mine, nor will the miner farm. Much mineral land can be used for agricultural purposes, and when such is the case, why not allow development of both the underground and the surface resources? Would it not be for the public welfare? If so, the welfare of the public should come first. Mining laws should not be framed wholly in the interest of the corporations, nor of the prospector; nor should mining development be prevented by grazing and agricultural interests. Idle patented claims should be so heavily taxed that they will eventually revert to the State.

Under the proposed new mining law, one discovery is sufficient to support the holding and patenting of 160 acres of contiguous claims. Also, all claims must be patented within seven years after location, except when a special extension is secured. These provisions are certainly against the interests of the people and of the prospectors. It is to the public interest that all resources be developed and that mineral land be worked. Patenting does not encourage such development. Most patented claims lie idle and pay only nominal taxes, whereas the producing mine has to stand the maximum taxation that can be given by the county assessors. All over the West are prospects and mines that have been shut-down for years, and that would now be working if they were held under leasehold and not under patent. Furthermore, most mining companies hold mining claims that they will never work. The land is patented, and none but the company can enter to prospect or to mine. The average mine-workings can be covered by one or two mining claims. Under the leasehold system, whenever an individual or a company takes up more land than it can develop, the annual tax on such idle lands tends to cause a release to the Government. Others then may have a chance to locate and to develop.

Why the proposed provision of the new law that mining claims must coincide with the lines of the public survey? It may make it easier for mapping purposes in the Surveyor General's office, but it will certainly be a handicap for the prospector and the locator.

If the gentlemen who framed these proposed laws had ever hunted for section-corners in remote places, perhaps this proposed location of claims along section lines would not have been advocated. I once searched all day for a section-corner in a Nevada town, examining rock-pile after rock-pile; the corner was finally found under the board-floor of a tent. In many sections, one could not find section-corners without a survey, and perhaps not then. Much of that surveying work was done by government contract, and in some cases the corners never were placed; just paper locations were made.

In San Diego county is some good mineral land. Last year, according to the U. S. Mines Report, the gold production was $71.11. Evidently, not one mine, and perhaps not a prospector worked last year in the whole county. And why? The best mineral land there is plastered over with old Mexican land-grants; and, outside of those ares, the proved mines have been patented. There is a dense growth of chaparral and manzanita along the best-known mineral belt, so dense that in many places a dog cannot pass through. A new-comer could not find a section-corner, nor a land-grant boundary, in a month. Who is going to pay for surveys to determine where he can or cannot prospect? If all mineral rights had been reserved by the Government and the land leased for mining, there would be mines working in San Diego today. Do we not all agree that the prospector should be encouraged? As to the new requirement for surveys, why put the prospector to that expense? New Zealand mine-laws have, or had, such a requirement before leasehold land could be held. The result was that no poor man could locate and hold Government mineral land.

The proposed abolishment of extra-lateral rights is a good thing for the mining industry and does the prospector no harm. How many prospectors ever sink deep

enough to go beyond their side-lines? A mining company or a locator now has to take up claims alongside the discovery claims to provide for the "dips, spurs, and angles", so as to try to prevent extra-lateral litigation. Under the proposed new laws, the locator can take up a claim or two alongside to provide for the dip of his discovery-vein outside the side-lines. Later on, should he find that he will not require such claims, he can let them revert to the Government.

If mineral patents are not granted, then there should be no requirement as to mineral discovery. Let the locator work and prospect, and if he employs men and buys materials, it helps the community near him. Most ventures of such a character will be losing ones, but in any case the community will be the gainer. When a locator or his successor develops a producing mine, the county and the State also profit.

Cretinly no person should be allowed to hold and to patent 160 acres of lode claims on one mineral discovery. I have sampled many such alleged 'mineral discoveries', after patent had been applied for, or granted, and the most of such discoveries would not sample 50c. per ton. On the other hand, many agricultural patents have been granted where there were indications that mines might have been developed by proper underground development.

The holding of claims for five years without discovery, provided the claims are worked, is a good law, as is also the limited-time extension after payment of the $50 per acre. Such money will not be paid unless there is a good chance; anyone who will pay $50 per acre for the privilege of prospecting and developing should be allowed to proceed.

In looking over the proposed laws, it would seem that the committee has considered the mine-law changes more from the viewpoint of the mine operator, rather than from that of the prospector or that of the general public. The mining laws should be drafted to aid the whole mining industry, and not solely for mine-owners and prospectors. Every individual in a mining district, or in a mining State, is directly interested, and therefore we should all make an effort to get the best mining code, one that will encourage and not retard the development of our mineral resources.

ALBION S. HOWE.

Sutter Creek, California, October 29.

The Editor:

Sir—We would like to register a protest against the proposed new mining law.

To locate and follow section-lines would be impossible here because in most places no section-corners can be found, and, while the valleys have mostly been surveyed, many of the mountain ranges where the ore is found are still unsurveyed.

The doubling of the size of mining claims would work a great hardship on prospectors as it would compel them to take up much more ground that would be of no value to them, and would compel them to do annually twice the amount of assessment work. Requiring them to pay $5 per acre instead of doing the assessment work would knock them out completely, because they haven't got the money.

Demanding $50 per acre from prospectors after five years simply means that they would all lose their claims, because most prospectors work until they haven't got 50c. let alone $50 per acre to pay for the ground. Of course, we know that this new law would not apply to most cases.

Fixing a time when patent must be applied for would also work a great hardship on many prospectors. In our own cases Sam Cocroft, after working six years, now has enough ore to make one small shipment so he can pay for his grub and keep on mining, but not enough to pay for patenting his mines. Before this he has had to take outside work to get a grubstake. R. A. Dean has worked 14 years and was compelled to work out every year for his grubstake and even now has not enough ore to ship.

Prospectors do not take up a claim unless there is an outcrop or some ore in sight, so they do not care to have a law giving them five years to find the ore.

Then we must consider well that our present mining laws are buttressed by many decisions from all our courts, including the highest, so that we now know quite positively just where we are. New court decisions would be required to clarify the new law and to make us know its meaning. We have read that it took 20 years to get court decisions so that the Sherman anti-trust law could be enforced. It would take at least as long, if not longer, to get this proposed new mining law adjudicated, and during all that time we would be working more or less in the dark.

The apex law might be improved by some changes but otherwise neither we nor any of the other prospectors and mine-owners here desire or wish any changes in the present law. In fact, we feel that the proposed new law would mean the total stoppage of all prospecting, so far as prospectors without capital are concerned, and that the present class of prospectors, who have done so much to develop our mining country in the past, would become extinct.

R. A. DEAN	FRANK E. ZADOW
SAM COCROFT	JOHN BLAIR
CARL F. MUIR	ALEX. GIRARDI
JAMES RECK	LOUIS LARRI

ED. GHIRARDELLI

Hamilton, Nevada, October 24.

Wetting and Amalgamation

The Editor:

Sir—S. H. Dolbear, in his notes that were published in the issue of November 12, is, I think, correct in assuming that the examiner of the Patent Office, who proclaimed an analogy between the amalgamation of gold by mercury and the wetting of a sulphide by oil, was mistaken in his ideas on the subject. The fact that gold is soluble in mercury has been known definitely for some

time. Recently, S. A. Braley and R. F. Schneider*, after confirmatory tests, came to the conclusion that, in the gold-mercury series, there are three eutectics, and three compounds—Au_2Hg, Au_2Hg_5, and $AuHg_4$; the last-mentioned compound was found to decompose into Au_2Hg_5 and mercury at its melting point.

A. W ALLEN.

San Francisco, November 14.

Agitation in Flotation

The Editor:

Sir—I am much interested in the article on 'Agitation in Flotation', by Frederick G. Moses in your issue of October 1, for it is a question of considerable importance, as Mr. Moses has intimated. Knowing him personally, I understand his keen interest in the discussion of flotation problems. With the hope of adding further light to a few of the points in this paper, I am undertaking to discuss some of them.

In connection with the question of the condition of the oil in a flotation pulp, many times the subject of considerable speculation, he states: "Thus, if the oils were properly emulsified, the mixture should remain in an exceedingly fine state of division indefinitely, or for a long period. But the oils, to be effective, must coat the sulphides and bubbles. If the oil is available for coating the bubbles, and sulphides, it cannot be thoroughly incorporated in the pulp; it should exist in a comparatively unstable condition, in order that it may be easily available".

In the first place, in spite of the work done by Bancroft, we are not certain as to the exact condition of most flotation oils in water. It is certain that, if an oil is effective, it must coat the mineral or adsorb on its surface; but there is no experimental evidence to support the statement "if oil is available for coating bubbles or sulphides, it cannot be thoroughly incorporated with the pulp", or for the statement that "it should exist in comparatively unstable condition in order that it may be easily available".

Soap unquestionably promotes emulsification of the oil, but it also does something else that I believe is more significant than this. Very small quantities of certain soaps lower the surface-tension of water to such an extent that oils will not spread on its surface. This was pointed out by me in a recent paper.† If flotation oil cannot spread on the free surface of water it certainly cannot be of use as a flotation agent. Such an oil might have been suitable for use in the old bulk-oil flotation process. If an oil does not possess the property of lowering the surface-tension of water, it would have no tendency to go into the water-air interface provided by the bubble, and oiled mineral particles would not be caught by the bubble. Bubbles as such have no attraction for mineral particles. Their function in flotation is to give added surface into which oiled mineral particles may gather, and to act as carriers of this surface to the free pulp-air surface where the minerals concentrate. This soap will tend to make pine-oils behave in their spreading properties on water as do the paraffin oils on clean water. Instead of forming a film, the oil will, on a soapy water, form as a lenticular globule.

The function of chemicals in a flotation pulp is a matter of speculation. It can, however, be determined that certain chemicals increase or decrease the amount of oil adsorbed on a unit of mineral surface; this is, no doubt, a result of an alteration of the interfacial tensions, solid-oil, solid-water, and water-oil.

If, for example, sulphuric acid affects the stability of an emulsion it cannot be shown experimentally, or it has not been done, that it is this effect that is doing good in flotation.

Mr. Moses states: "On the assumption that emulsification may be carried too far, it is possible to explain why ¼ lb. of oil added to four different places in a series of cells will be more effective than 1½ lb. of the same oil added to the head of the cell". I would offer the following explanation for this well-known and advantageous method of adding the oil. In the paper it was pointed out that all minerals, including gangue minerals, adsorb oil when agitated with a mixture of oil in water. It is a question of degree only. The sulphides adsorb very much more oil than gangue minerals, such as siderite and quartz; this is particularly true of emulsions of lower concentrations of oil; for the higher concentrations the gangue minerals adsorb comparatively more oil. Incidentally, this explains why the addition of excessive quantities of oil causes the flotation of much gangue, and it points to one way in which much of the 1½ lb. of oil, if added in one batch to the first of a series of cells, would be inefficiently used. Another way in which most of the oil is used ineffectively in this kind of practice is in the large quantity frothed in the first cell. The surface concentration of the oil on the bubbles is high; and, because of the low surface-tension, many more bubbles are formed in the first cell than in any succeeding one.

Mr. Moses in enumerating the important functions of air, states that "it is necessary, in order to increase surface-tension or air-water interface, so that the froth may float". Just what the increase in surface-tension has to do with the floating of the froth is not clear. It is also not clear what the air-water interface has to do with the floating of the froth, although the introduction of air-bubbles undoubtedly increases the air-water interface.

Farther on in the paper it is stated that "a sulphide will not float readily if wetted by water. It is the air that displaces the water and prevents it from wetting the sulphide. Air or some other gas must be present in the water to prevent it from wetting the sulphide". The first sentence is true enough, but it is not my conception of flotation that "it is the air that displaces the water and prevents it from wetting the sulphide".

In the skin-flotation process it is probably true that the particles resting on the surface of the liquid are sur-

*Jour. Amer. Chem. Soc., April 1921.

†'Surface Energy and Adsorption in Flotation', 'M. & S. P.', Aug. 13, 1921.

rounded with a film of air, but it is certain that in modern froth flotation at the beginning, all the ore particles in a pulp, both gangue and mineral, are wetted with water. When oil is added and mixed, the water on the surface of certain mineral (sulphide) particles is displaced by the oil, whereas others remain wetted with water. The particles whose surfaces have been wetted by oil are thus enveloped with a substance that is eager to lower the surface-tension existing at the pulp-air (bubble) surface, and it will thus be drawn into the interface all the time, being completely covered with a film of oil, which film it retains until subsequent metallurgical treatment, such as roasting at the smelter, destroys the film.

A. W. Fahrenwald.

Moscow, Idaho, October 21.

Chilean Nitrate and Its Competitors

The Editor:

Sir—As the able and comprehensive editorial on 'The Domestic and Foreign Supply of Nitrate' (which I translated for the 'Boletin de la Sociedad Nacional de Mineria', of Santiago, and discussed therein) seems to have aroused a considerable amount of attention, I trust that the information that follows will be of interest to your readers.

It is true that the price of nitrate is fixed in Chile by the Asociación de Productores, but lately the London 'pool' has exercised its influence to prevent a reduction. The quotation of 18 shillings per quintal reached in March 1920 was undoubtedly too high; as the demand slackened in response to causes that will be analyzed later, the price also dropped; in April of next year farmers will be able to obtain Chilean nitrate for about half that price. Mr. Mason's remarks call for comment. Crookes had some ground for his pessimism, because of the wasteful methods of beneficiation then, as well as now, in practice in Chile. How great was the influence that the storage of nitrate in Germany previous to the War had in making production of Chilean nitrate reach the enormous figure of 2,500,000 tons in 1913 will be difficult to ascertain; in spite of the great war demand, the output of refined nitrate only reached 3,000,000 tons during 1916 and 1918. The amount of caliche treated to date does not reach one-fifth of the total that is susceptible of exploitation. What amount can be treated by more economical exploitation and beneficiation would be difficult to estimate. The grade of caliche has decreased considerably. Caliche with 20% or more of nitrate is considered high-grade; 17%, average; and 12%, low-grade. The ability to extract the nitrate from what is now considered as low-grade caliche has resulted from economies introduced, not because of the discovery of a revolutionary process of treatment.

The development of the different nitrate-producing industries has been as follows:*

*Taken mainly from a communication by A. Bertrand to the Asociación de Productores.

Chilean Nitrate. During the first 28 years following the War of the Pacific, and the acquisition by Chile of the Provinces of Tarapacá and Antofagasta, the production of nitrate increased at an almost uniform rate of 65,000 metric tons per annum. This represents an increase in output of from 225,000 tons (1880) to over 2 million tons (1908). From 1908 to 1913 the rate of increase in production rose to 186,000 tons per annum. At the beginning of the War there was a decrease (1914-1915), and from 1915 to 1918 a great increase, which in 1918 resulted in a total output of 3 million tons. The War also caused the loss of the Austro-German market (900,000 tons per annum), which has been partly offset by increased exports to Spain, to the United States, to Japan, and to various other countries, which together amounts to 850,000 tons over and above the pre-war figures. During 1919 the production fell to about one-half that of the previous year, or 1,700,000 tons. There was a recovery last year, production again going up to 2½ million tons, the exceptional price of 18 shillings per quintal being recorded in spite of the heavy stocks that had been accumulated (2¼ million tons), as compared with the normal stocks of pre-war years (1,700,000 tons). Today the industry is practically at a standstill; several causes are contributory, the main ones being: (1) The high price of nitrate, 14 to 17 shillings per quintal, f.o.b. Chilean ports. (2) The depressed currency of European countries, and especially of Germany and Austria, which prevents them from buying nitrate from Chile. (3) The enormous development of the synthetic industry during the War, as well as the greater output of ammonium sulphate—a by-product of the coke, gas, and iron industries. (4) The fall in the value of agricultural products, which does not permit farmers to buy an expensive fertilizer.

Production of Fertilizers by Countries. In 1913 Germany produced 550,000 tons of sulphate of ammonium. Today the amount is at the rate of about 300,000 tons per year as a result of the industrial upheaval caused by the War, and the loss of some of her coalfields. The future production of this fertilizer depends on industrial recovery. The growth of the synthetic-ammonia industry in Germany can be judged by the following figures:

Year	Approximate tons, in terms of sulphate of ammonium
1913–1914	35,000
1914–1915	150,000
1915–1916	300,000
1916–1917	540,000
1917–1918	840,000
1918–1919	500,000
1919–1920	500,000
1920–1921	700,000

It is said that today Germany is in a position to produce 140,000 tons of synthetic nitrogen (700,000 tons of sulphate); these figures may be increased eventually to 240,000 and 1,200,000 tons, respectively. The present production of cyanamid in Germany has been estimated variously at between 375,000 and 500,000 tons per year, which represents between 75,000 tons and 100,000 tons of nitrogen. The maximum productive capacity of Ger-

many is thought to be about 600,000 tons of cyanamid per annum.

The production of sulphate of ammonium from coal rose in the United States from 150,000 tons per year in 1913 to 500,000 tons in 1920. With regard to synthetic-nitrogen products, the only producing plant is situated on the Canadian side of Niagara, and belongs to the American Cyanimid Co.; it is capable of producing 60,000 tons of 20% cyanamid. What has befallen the two government plants, at Sheffield and Muscle Shoals, is too well known to need comment.

The production of ammonium sulphate in Great Britain, which was 443,000 tons per annum before the War, rose to 459,000 tons in 1917. Last year it fell to 375,000 tons on account of strikes and other causes. The government plant at Billingham, for the production of synthetic ammonia by the Haber process, was not finished at the time of the Armistice. It has been taken over since by the firm of Brunner, Mond & Co., which formed a syndicate with a capital of £5,000,000 to acquire and finish the plant. Another company, called the Atmospheric Nitrogen & Ammonia Products, Ltd., was formed in 1920 with a capital of £2,500,000 to exploit the patents covering a process at present being tried in France.

The production of ammonium sulphate derived from coal in France is 45,000 tons, as compared with 75,000 tons made before the War; the destruction of the northern regions of France by the Germans is responsible for this decrease. A company with a capital of 12,500,000 francs has been formed in France to exploit the Haber process, but nothing has been done. The Claude process, which effects the production of synthetic ammonia under a pressure of 1000 atmospheres, is being worked on a semi-industrial scale and is said to have given satisfactory results. The production of cyanamid by the Government has proved a failure in France, and the 7 *usines* that were constructed during the War at a cost of 400,000,000 fr. for the fixation of nitrogen by this process have only produced 30,000 tons per year instead of the calculated 300,000.

Table I gives the world's production of nitrogen contained in the products manufactured from 1913 to 1920. The figures represent thousands of tons.

Table I

Product	1913	1914	1915	1916	1917	1918	1919	1920
Chilean nitrate	430	382	273	452	467	446	251	391
Sulphate (coal)	290	225	275	146	200	240	260	285
Sulphate (synthetic)	7	31	63	114	180	200	120	140
Cyanamid	35	45	45	95	135	130	140	160
Nitric acid	10	11	11	11	11	18	25	28

Note. One ton of nitrogen represents the nitrogen contents of 6.5 tons of sodium nitrate, or 5 tons of ammonium sulphate.

Table II

Maximum productive capacity in 1921 of different countries, in thousands of tons of nitrogen

Product	Chile	Germany and Austria	Great Britain	United States and Canada	Norway and Sweden	France and various	Totals	%
Chilean nitrate	520	...	...	...	...	...	520	33
Ammonium sulphate (coal)	..	105	95	100	...	140	440	27
Ammonium sulphate (synthetic)	..	300	...	...	...	...	300	19
Cyanamid	..	120	...	57	23	100	300	19
Nitric acid	..	...	...	1	28	1	30	2
Totals	520	525	95	158	51	141	1590	100

The output of cyanamid in Norway and Sweden is at present about 20,000 tons per annum. About 130,000 tons per annum of calcium nitrate is being produced by the electric-arc process.

The following figures show in percentages the relative position of Chilean nitrate and its competitors from 1894 to 1921; Chilean nitrate has been losing ground steadily:

	1894	1904	1913–1914	1921
	%	%	%	%
Nitrate	73	66	56	33
Competitors	27	34	44	67

The only nitrogenous inorganic fertilizers employed in agriculture up to ten years ago were Chilean nitrate and ammonium sulphate. At the present time two more have reached appreciable figures in statistics: cyanamid and nitrate of calcium. To these must be added other ammoniacal salts, the intensive production of which is a direct result of the development of the explosives-making industries during the War, and various mixed salts and combinations produced with the intention of obtaining a complete fertilizer, that is to say, one containing nitrogen, phosphoric acid, and potash.

The nitrogenous inorganic fertilizers, classified according to decreasing percentage of nitrogen, are given in Table III.

Table III

	Nitrogen %	Phosphoric acid	Potash
Urea	46.4	.....	...
Ammonium nitrate	34.0	.....	...
Urea nitrate	34.0	.....	...
Ammonium nitro-sulphate	27.0	.....	...
Ammonium chloride	25.0	.....	...
Ammonium sulphate	20.0	.....	...
Calcium cyanamid	19.0	.....	...
Ammonium carbonate	18.0	.....	...
Ammonium nitrate (potassic)	16.0	.....	8.0
Sodium nitrate	15.5	.....	...
Calcium nitrate	13.0	.....	...
Ammo-phos	15.0	12–14	...
Ammonium superphosphate	7.15	12–14	...
Ammonium superphosphate (mixed)	6.0	10–12	...

Salitre, or Nitrate of Soda. Nitrate is suitable as a fertilizer for crops that are planted at a shallow depth. The soda is transformed into the carbonate, which is a useful corrective for acid soils; it liberates potash from its combinations when this is needed. *Per contra,* in argillaceous soils the sodium residue tends to make them heavier. Experience has shown that the continued use of saltpetre benefits soils. The efficiency of Chilean nitrate is recognized as high; it is always taken as the standard for comparison with other natural or synthetic fertilizers.

Calcium Nitrate. This fertilizer has similar applications to Chilean saltpetre. It contains calcium instead of sodium, and produces a strengthening effect in certain plants; soda is preferable for pastures and roots. It does not increase the heaviness of argillaceous soils, but its contents in lime are not sufficient to be taken into account because of their physical effects, which are the ones sought for when lime is added (5 or more tons per hectare) to soils which used it. The most serious disadvantage of calcium nitrate is its high hygroscopicity, which makes it necessary to ship it in hermetically sealed boxes; it must be used immediately. The efficiency of

calcium nitrate per unit of nitrogen is the same as that of Chilean nitrate; according to recent experiments, the latter gives an added yield of 3% in common rye and beet-root, and up to 27% in fodder-roots; calcium nitrate gives an added yield of 2% in potatoes, 5% in wheat, 9% in oats, and 10% in barley.

Ammonium Sulphate. This fertilizer is not suitable for use in shallow-sown crops, except before sowing. Its effects are, as a general rule, as sure as those of saltpetre. Its efficiency is somewhat less, for it varies between 83 and 97%, and in exceptional cases as much as 75% of Chilean nitrate, according to the crops, the soils, and the experimenters. The sulphate of ammonia from gas-works is acid, and often contains elements that have a toxic effect on plants. Endeavors are being made to produce a neutral sulphate that may compete in purity with that derived from synthetic ammonia. There are especial cases where its efficiency is equal to that of Chilean nitrate; in the cultivation of rice the sulphate is superior.

Cyanamid. This cannot be used in shallow-sown crops. Its transformation in the soil is complex. It produces urea first, then ammonium carbonate, and lastly nitrate. It has several defects. The first is due to fineness; the second, to causticity, on account of the quicklime it contains; the third, because of losses of nitrogen. Cyanamid has been oiled, tarred, and granulated, without satisfactory result. The complexity of the decomposition of cyanamid in the soil causes its effects to be more varied and insecure than is the case with other nitrogenous fertilizers; the proper conditions for the use of cyanamid are yet unknown. According to experiments, which have lasted already more than ten years, the efficiency of cyanamid per unit is from 6% to 14% lower than that of sulphate of ammonia, and 17% to 25% lower than Chilean nitrate.

Ammonium Nitrate. This salt combines, theoretically, the advantages (rapidity of the first effect) with those of the sulphate (prolonged effects); its high degree of concentration results in an economy in freight. In actual practice it has serious drawbacks; it is explosive, it is hygroscopic, and it has a tendency to agglomerate. Its efficiency, according to experiments made in Great Britain during the War, is said, in certain cases, to have been superior to that of Chilean nitrate; but the results need confirmation.

Ammonium Chloride. The effects and efficiency of this fertilizer are comparable with those of the sulphate. It is possible that, for financial reasons, this salt may prove a substitute for the sulphate in the utilization of ammonia obtained from coal.

Ammoniacal Superphosphates. A product thus called in Germany is a simple mixture of the superphosphate of commerce with ammonium sulphate that contains 5 to 6% of nitrogen and 10 to 12% of phosphoric acid. It is usual to add up to 8% of potash in order to make a complete fertilizer. The true ammonium superphosphate is a salt that has been saturated with ammonia gas by absorption and that contains from 6 to 8% of nitrogen and 12 to 14% of phosphoric acid. Efforts are being made in the United States to produce one that will contain from 10 to 16% of nitrogen and up to 40 or 50% of a suitable acid. Such would constitute an ideal universal fertilizer with which, owing to the high concentration of all its elements, the present charges for loading, transport, mixing, sacking, transhipment, and spreading on the soil would be reduced to the minimum.

Studies and experiments in this direction are being conducted in the United States and Germany, where such products have been put upon the market in small quantities as an experiment.

F. Benitez.

Santiago, Chile, August 24.

Mechanical Efficiency of Flotation-Machine Impellers

The Editor:

Sir—A method that has proved satisfactory in estimating the mechanical efficiency of flotation-machine impellers is to fill the machine with water until it overflows, then to empty it, measuring the water to obtain the total volume of the machine (A). Then run the machine with an impeller to be tested, adding water until an overflow is obtained. Stop the machine and empty it, to obtain the volume of water contained when running (B); $A-B$ represents the volume of bubbles formed when running. Care must be taken that the water or solution used in each case is the same, otherwise the results will be vitiated by the difference in the frothing quality of the liquor. Different impellers can thus be compared.

The same method may prove of advantage in testing oils or other reagents, enabling results to be obtained without performing complete flotation tests with ore, and saving the cost and bother of assays, if complete tests are used to control such estimations. Correction must be made for the difference in volume of different impellers or baffles. By taking the original volume of the water in the machine as 100, and the running volume as a percentage of the original, different machines may be compared; the percentage frothed is of more interest than what remains. For instance, by running a 45° shrouded impeller backward, 21% was frothed; by running it forward, 36% was frothed; and by running it forward after the addition of eucalyptus oil, 47% was frothed. An impeller with four blades at 90°, shrouded, in water, frothed 35% of the original volume; an open impeller, not shrouded, with four blades at 30° from the horizontal frothed 32% of the original volume when eucalyptus was used. When it is desired to modify the intensity of frothing, this method of obtaining a numerical value of the result of change of such a factor as speed is of value.

Alfred T. Fry.

Queenstown, Tasmania, September 23.

Use of Scrapers Underground

By Lucien Eaton

For the past ten years, and especially for the last five years, mechanical methods of loading ore underground have received increasing attention from mining men throughout the world. The number of designs of mechanical loaders that have been made is very large, and is continually increasing. Comparatively few of these machines have been successfully operated, and their field of operation, with a few exceptions, is limited to drifts and open stopes. Recently, however, some new types of mechanical loader have been developed that are said to be economical and effective when used on sub-levels. A good description of the various kinds of loaders manufactured was given by A. M. Gow in an article in the 'Engineering and Mining Journal', Vol. 109, No. 5, which covered the subject practically up to 1920.

One of the recent developments in mechanical loading underground is the use of 'scrapers' or 'slushers,' and this type of loader has been so successful, that, until the depression in the mining industry became severe, there was hardly a district in which experiments were not being carried on. In an article entitled 'The Use of Scrapers in Metal Mines,' published in the May 1921 number of the 'Compressed Air Magazine' (No. 5, Vol. XXVI), I described some of the successful types of scrapers and the ways in which they were used, and discussed briefly the principles of their design.

For many years the horse-drawn 'slip-scraper' or 'slusher' has been in commmon use about mines for moving earth short distances on surface, but it was only with the development of small portable compressed-air hoists that its use underground was attempted. One of the first and most successful instances of its adaptation to underground conditions was at the Spruce-Adams mine of the Oliver Iron Mining Co., a producer of soft hematite ore on the Mesabi range at Eveleth, Minnesota. At this mine the ore is moved by 3½-ft. slushers (Fig. 1), pulled to the chute by Little Tugger air-hoists, and dumped by hand. The slusher is dragged back to the ore-pile by hand and filled in the usual manner. This method is extremely simple and flexible, and is very effective in finely divided material for distances up to fifty feet, but it entails extremely hard labor on the part of the man who handles the slusher. The rate of loading is from 10 to 14 tons per hour, and the production per man per shift is said to have been increased 23% over hand-shoveling.

It was seen quickly by those who experimented with the slip-scraper underground that, except under very favorable circumstances, the success of this method of moving ore depended upon the elimination of the continual walking back and forth with the scraper; therefore some means of loading and dumping the scraper automatically, was sought. The bottomless type of scraper, with or without sides, using a tail-rope, was the result. C. L. Lawton, manager for the Quincy Mining Co. at Hancock, Michigan, in the Lake Superior copper region, was one of the first to develop successfully a scraper of this type. He used a modification of the Bagley scraper (Fig. 2), having sides but no bottom, in open stopes for pulling broken ore down a foot-wall dipping between 30° and 40°. The scraper has two digging-edges, one equipped with teeth for use in coarse rock, and the other smooth, made of steel plate, for use in fine material. This scraper weighs over 400 lb. and is moved by a double-drum air-driven hoist with 5 by 6-in. cylinders, and moves about one ton of ore at each trip. It loads into ore-cars through chutes.

At about the same time, 1915, or possibly earlier, a bottomless scraper of a different type (Fig. 3) was developed in the lead-zinc districts of Missouri and Wisconsin. This scraper has no sides and is equipped with teeth. The usual motive-power is a double-drum geared hoist belted to an electric motor. Some large scrapers of this type have been built, and the tonnage moved has been remarkably large. The scrapers are used in open stopes and pits, usually dragging the ore into chutes.

A modification of the Joplin scraper just described was made by the engineers of the Calumet & Hecla Mining Co. in order to adapt it to their underground conditions. This scraper is shown in Fig. 4. It is large and heavy, weighing over 700 lb., and has been successfully used in stoping, in pulling ore down the foot-wall in stopes too flat for the ore to run by gravity, and in loading cars in drifts by dragging ore or rock up an incline. Similar scrapers have been used by several other mining companies in the same district. In using this scraper for loading cars in drifts a platform of 2-in. planks is built on a framework of 6-in. square timber high enough for cars to pass underneath and long enough for two to five cars. At the end nearest the breast there is an incline built of the same material on a slope of one foot in three, and a suitable hole is cut in the horizontal platform, through which the ore falls into the car below. A 6 by 9-in. double-drum geared hoist is mounted on the rear end of the platform, and the snatch-block for the tail-rope, or back-haul, is attached to a 4-in. bar or a sprag set in the breast. In order to ensure smooth travel for the scraper along the floor of the drift, rails are laid for it to slide upon. By this means 150 tons of rock per shift can be loaded and the radius of action increased to more than 125 feet.

An interesting loading arrangement planned for the Newport Mining Co. at Ironwood, Michigan, is a further development of the Calumet & Hecla practice. In loading

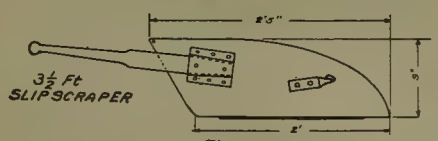
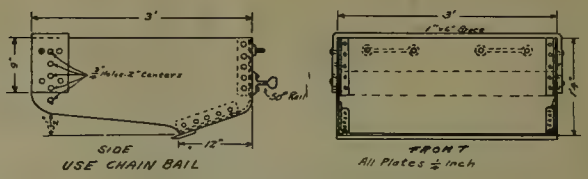
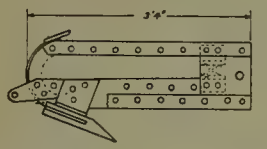


FIGURE 1



SCRAPER FOR SOFT ORE

FIGURE 5



QUINCY 30-INCH
STOPE-SCRAPER
FIGURE 2.

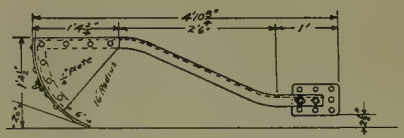
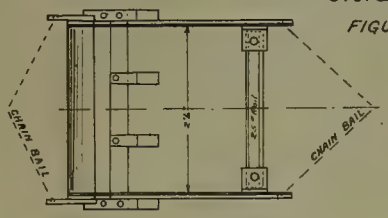
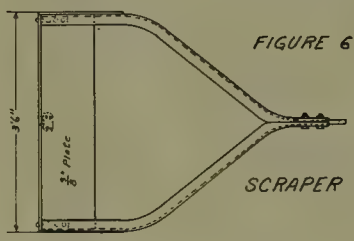


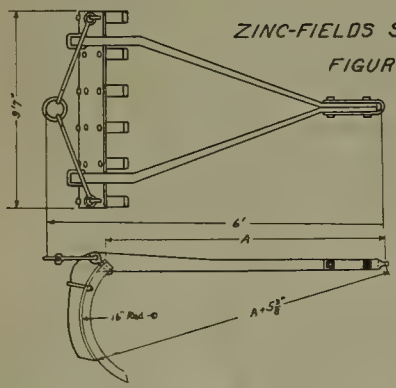
FIGURE 6

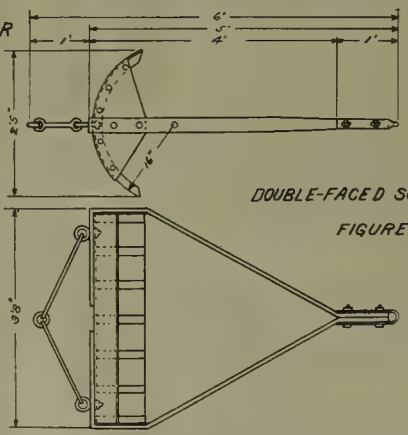




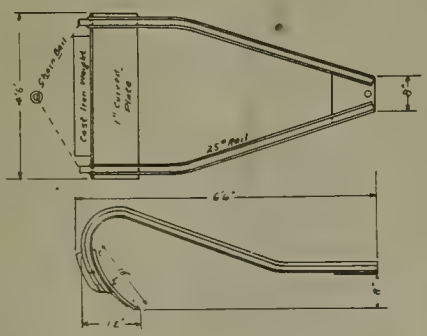
SCRAPER FOR SOFT ORE

ZINC-FIELDS SCRAPER
FIGURE 3.



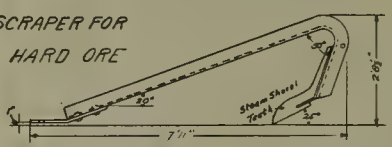


DOUBLE-FACED SCRAPER
FIGURE 7.



CALUMET & HECLA DRIFT-SCRAPER
FIGURE 4

SCRAPER FOR
HARD ORE



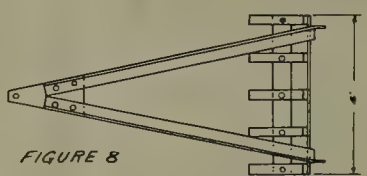


FIGURE 8

ore or rock in main-level drifts it is planned to use the cars themselves as a loading-platform. The cars are to be equipped with vertical extensions on the sides and with loose horizontal plates overlapping the ends, similar to those used on gravel-trains on railroads, where plows are used to remove road-ballast from flat cars. A small hoist is to be mounted on a flat car next to the electric locomotive, and an inclined iron apron is to be laid up to the end of the car nearest the breast. It will also be necessary to provide rods or straps running lengthwise on the tops of the cars to prevent the scraper from digging in as it passes over them. In operation the train will be backed close to the breast, a snatch-block will be hung from a bar across the breast, the hoist connected either to the trolley-wire or the air-line, and the incline adjusted to the end of the first car. The scraper will then be used to drag the broken ore up the incline into the cars, which will be filled successively. When the last car has been filled the scraper will be hauled upon the flat car with the hoist, the rope taken off the snatch-block and wound up, the incline taken down and the hoist disconnected from the power-line. The train will then proceed to the shaft, where the cars, which are gable-bottomed, will be dumped without uncoupling.

In the soft-ore mines on the Marquette range several types of scrapers have been used successfully. At the Isabella mine at Palmer, Michigan, Capt. T. J. Nicholas used a light scraper of the Quincy type for dragging ore down long raises that were too flat for the dirt to run by gravity. The unique part of this equipment was that he used a single-drum Little Tugger hoist with a dividing flange in the middle of the drum, and reversed the hoist when pulling the scraper back up the raise. The adjustment in the tail-rope for different positions of the snatch-block was obtained by means of a small drum attached to the back of the scraper. The loose end of the rope was wound on this drum and was paid out as the length of the haul increased.

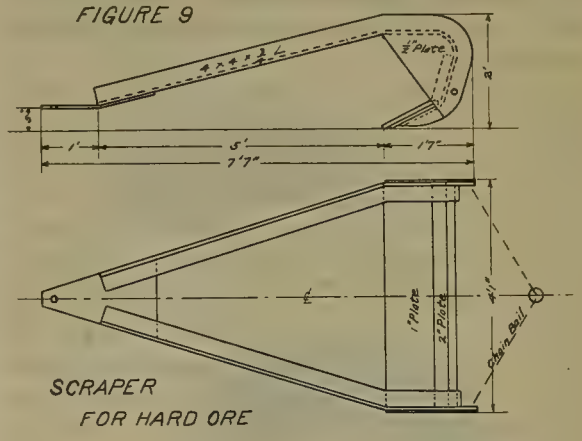
Another modification of the Quincy type of scraper, shown in Fig. 5, has been successfully used at several mines for pulling ore and rock into chutes, and also for dragging it up an incline into a car. This scraper does not work well in coarse material.

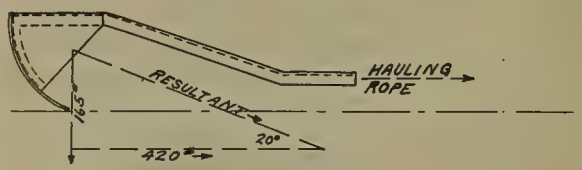
The scrapers shown in Fig. 6 and 7 work better in coarse material, especially the latter, which is heavier and has the advantage of two digging edges, one of which is equipped with teeth for 'combing out the chunks'. This scraper is a favorite with the miners, and is suitable for both hard and soft ground. When loading into chutes these scrapers have a capacity of 30 tons per hour from 50 feet.

At the Cliffs Shaft mine of the Cleveland-Cliffs Iron Co., which is a producer of hard specular ore of high specific gravity, I was experimenting with scrapers up to the time the mine was closed, on June 1, 1921. The ore at this mine breaks into large pieces, which often weigh from 500 to 1000 lb., and is difficult to handle. Heavy equipment was necessary, but under favorable conditions excellent results were obtained. Two types of scrapers were used, one with teeth and one without, sketches of which are shown in Fig. 8 and 9. The scraper with teeth worked best in large piles of coarse ore, and under favorable conditions loaded as much as 100 tons in an hour, dragging the ore into a chute.

Recently various types of scrapers have been put on the market for loading sand and gravel, some of which

FIGURE 9





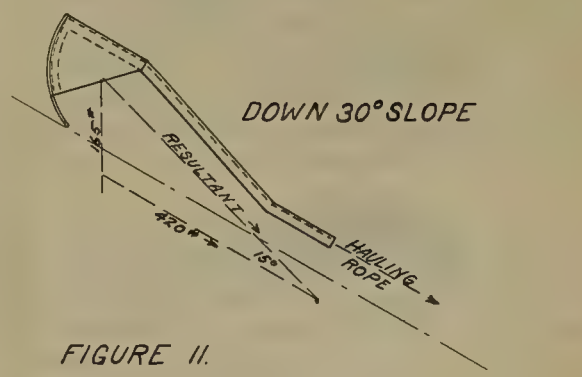
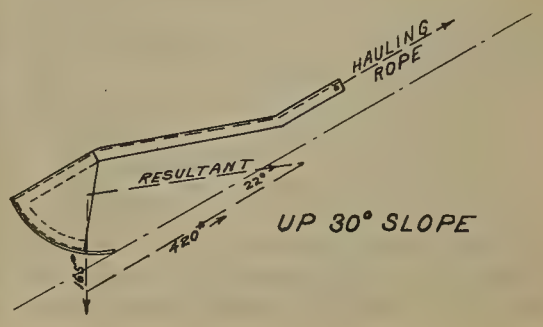


FIGURE 11.



may prove successful underground. The four scrapers manufactured and sold by Sauerman Bros. of Chicago, shown in Fig. 10, were designed to stop digging as soon as full, and quite probably may be adapted to underground use. The Le Clair scraper is somewhat similar to one of the designs of scraper sold by the Goodman Mfg. Co. for loading coal underground. A description of the Goodman apparatus was given by Mr. Gow in his article referred to above, and in the Goodman Mfg. Co.'s handbook.

Although the hoe type of scraper is suitable for nearly all kinds of material, in its design account should be taken of the conditions under which it will have to work. The most important considerations are the angle of the cutting-edge, the weight of the bail, and the point of attachment of the haulage-rope. The maximum digging power will be obtained when the angle of the digging edge lies in the resultant of the pull and the force of gravity. It would seem simple to determine this angle, but unfortunately both of these forces are variables. The hauling force is usually applied approximately parallel with the surface of the broken ore, or, when hauling away from the pile, parallel with the floor of the drift, and from four to eight inches above it. The force of the pull, however, is not constant, being greatest when the scraper is taking its full load. The force of gravity as represented by the weight of the scraper is a constant, but the direction of its application with respect to the long axis of the scraper varies with the angle of the pile and the position of the scraper. It is quite evident from an inspection of Fig. 11 that the resultant of the forces exerted by gravity and by the pull of the hauling-rope is at a more acute angle with the line of pull, when the scraper is pulling material down-hill than when it is pulling it up-hill. The digging edge should vary accordingly. In practice the angle of the digging edge varies from 15° to 30°, and is usually about 20°. The same scraper may be adapted to different inclinations by having the point of attachment of the hauling-rope adjustable vertically in the same manner as is done with plows.

The bail should be so designed that it will slightly over-balance the weight of that part of the scraper that lies behind the cutting edge, so that no time will be lost in righting the scraper at the beginning of the forward pull. This is especially important in cleaning out the breasts of drifts. The hauling-rope should be attached to the bail at a point from four to eight inches above the floor. This is the position the front end of the bail will assume in operation, and it must therefore be taken into consideration in the design.

The weight of the scraper should be suited to the work it has to do, that is to say, to the size and weight of the pieces of broken ore, and to the amount of handling it will require. The size must be a compromise between capacity and portability. In general, I should say that a scraper should be about half as high as it is wide, in order to minimize the tendency toward overturning, and that the length should be roughly one and a half times the width. The width varies in practice from 30 to 54 inches, and the weight from 160 to 1000 pounds.

The hoist best suited for hauling scrapers has been given much consideration of late. The larger scrapers, handling a ton or more at a trip, require engines of 15 to 30 hp. and speeds up to 400 ft. per minute. The engine should be capable of exerting its maximum pull at slow speeds, for, especially in coarse material, the scraper must have time to settle down between the chunks and take hold. If pulled too rapidly over the pile it will bounce from chunk to chunk without picking up a load. High speed is necessary after the scraper has left the pile, and also on the back-haul. The Lake Shore Engine Works, of Marquette, Michigan, builds a double-drum scraper-hoist with 6 by 9-in. cylinders that meets the requirements of large scrapers admirably. I have used successfully a double-drum Lidgerwood hoist with 6¼ by 8-in. cylinders, and re-built some of the No. 34 single-drum hoists of this make, substituting two narrow drums of 10-in. diameter for the standard 14-in. drum.

For the smaller scrapers, which are being used in soft ore and on sub-levels, a less powerful hoist is required. The Ingersoll-Rand Co. has designed and built an admirable little hoist for this work, which is called the 6-H Little Tugger. It is driven by compressed air and has a Doak engine developing about 5 hp. There are two drums loose on the shaft, with clutch and brake, with capacity for 250 ft. of ⅜-in. wire-rope. The maximum rope-speed is 200 ft. per minute, which is ample. The machine is very compact and weighs a little over 500 lb. The Sullivan Machinery Co. manufactures a small turbine-driven single-drum hoist of about the same capacity. Either this or the Waughoist, manufactured by the Denver Rock Drill Mfg. Co., if equipped with double-drum, would be as good as the 6-H Little Tugger.

Of the electric hoists, the Lake Shore Engine Works and the Goodman Mfg. Co. have the only special designs that I know of. The Lake Shore electric hoist has a 7 hp., 220 v., d.-c. motor driving, through a worm-gear, two narrow drums which are equipped with strong friction-clutches. Its only drawback is its weight, which is about 1400 lb. It develops a pull of over 2000 lb. at a speed of 125 ft. per minute. In the Joplin district tandem double-drums are belted to an electric motor, the belt giving the slippage necessary to prevent burning out the motor when the scraper stalls.

There is a difference of opinion as to the superiority of having the drums in tandem or side by side on the same shaft. I rather favor the latter arrangement with narrow drums. In my article in the 'Compressed Air Magazine' I recommended having both drums loose on the shaft, with friction-clutches. Later experience leads me to believe that one drum may be tight on the shaft and the other need have only a jaw-clutch, provided the engine has a reversing-throttle. This makes the engine a single-lever machine, which can be operated, if necessary, by a one-armed man, and the cost of construction is considerably less than it is with two friction-clutches.

The small hoists are commonly mounted on 4-in. or

4½-in. posts, but they can be mounted on skids. The large hoists are mounted on skids or platforms. The snatch-block for the tail-rope is usually hung from a 3-in. bar set across the upper part of the drift close to the breast in drifting, and from a chain or wire-rope stretched between eye-bolts in open stopes. Additional snatch-blocks are often used when the hoist is not in position for a direct pull. The ordinary snatch-blocks are not strong enough for use with scrapers, but the special blocks built for skidding logs in lumbering operations give satisfactory service. The usual practice is to buy the sheave and have the mine blacksmith make the frame and hook.

The field of application of scrapers is wide, but they are especially suited for use in open pits, in open stopes, and in drifts. For milling ore into chutes and for dragging ore down open stopes or rooms where the foot-wall dips at less than 45° they are superior to any other device on the market. In drifting on sub-levels where the ore is dumped into chutes the use of scrapers has increased progress nearly 40%, with a corresponding decrease in the cost of labor. In stoping by the top-slicing method there is some difficulty in using scrapers on the side-slice, unless the first slice is carefully lagged, so as to keep the ore, as blasted, confined within the limits of the drift. It has also been found inexpedient to try to drag a scraper around a right-angle turn, but nearly the same result can be obtained by making two 45° turns one set apart, the side of the drift being planked up around the turn for a height of two feet. For this work the scraper should have for the tail-rope a back-bail, fastened to the rear corners, so that those corners will not catch on the timber in rounding the turn on the back-haul.

Like nearly all mechanical loaders, scrapers are not suitable for handling ore that has to be sorted as it is loaded. Experience has also shown that they are not particularly satisfactory in drifts where much water is dropping. I recall one case where a drift was being driven through soft ore, and a good deal of water was dropping from the back. The scraper dug unevenly in the bottom of the drift and piled loose dirt along the sides, so that it was impossible to keep a ditch open; and during the time when the miners were drilling and timbering the low spots in the drift filled with water, so that passage was difficult. After blasting, when the scraper was started, it would pull all the accumulated water into the chute, and the water would wash the ore out of the chute upon the track on the main level below.

The chief points of superiority of scrapers over most mechanical loaders are lower first cost, lower maintenance, and greater flexibility. The cost of operation seems to be about the same. The main disadvantage is that in drifting the drilling cannot be done while the scraper is in use. This is not necessarily the case in stopes.

There is a fairly wide variation in cost of operation. With the smaller outfits dragging ore forty to fifty feet the cost of loading is approximately half that of shoveling, and about 5000 tons must be handled before the first cost has been earned, that is to say, the whole outfit will pay for itself in four to six months. The larger equipment makes a greater saving over hand-shoveling roughly proportional to its greater first cost and greater capacity, so that about the same length of time is required for it to pay for itself.

The use of scrapers underground is in its infancy, and, no doubt, when mining operations are resumed, a technique of its own will be developed, and new applications

FIG. 10. SAUERMAN SCRAPERS

discovered or worked out, which will be of great interest to the profession and value to the industry. Meanwhile an exchange of views on the subject by men who have been using scrapers will be a long step forward.

THE Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground", from several countries. These imports are partly pebbles for use in grinding-mills. The value of such imports during 1920 was $338,630.

Time Studies in Metallurgical Analysis

By W. F. Dietrich

Introduction. This paper is a preliminary report on the application of detailed time studies to instruction in metallurgical analysis in the Department of Mining and Metallurgy of Stanford University, and is concerned chiefly with the utility of such studies as an aid to instruction. It is presented at this time in order to stimulate thought on the subject, in the hope that others will feel inclined to make similar studies with the object of obtaining eventually a set of standards for each important manipulation. Such time standards could be applied not only to instruction but also to plant practice, and would be especially desirable in determining the best procedure for a given determination. The standards given in this paper must not be considered as final, as they are the results of the first application of the method to student work in connection with this course.

The Course in Metallurgical Analysis. This covers technical methods of analysis of copper, lead, zinc, iron, sulphur, insoluble, lime, magnesia, and silica. The course at present is open only to graduate students who have previously taken courses in qualitative and quantitative analysis (10 lectures and 150 laboratory hours in each). The time allotted to this course is 90 hours of laboratory work. A syllabus gives the schemes for the analytical methods to be used. The student is expected to memorize each scheme before using it, and to be prepared to answer questions on the theory of the method.

It has been found desirable at Stanford, as elsewhere, to give this work in the Metallurgy Department in order that students may have the opportunity to become sufficiently proficient to analyze the products of metallurgical tests without consuming an undue amount of time on the purely analytical work, thus leaving more time for actual testing. It is also important that the young metallurgist be well trained in metallurgical analysis in order that he may have a ready means of entering his chosen profession.

During the student's sojourn in American universities, generally, little or no attempt hitherto has been made to impress upon him the necessity for high personal efficiency in his daily life in order that he may accomplish the greatest amount of useful work in a given time. The extra class-work of the typical university course consists of a definite quantity of work to be completed, it is true, on a given date, but without particular reference to the time required by each individual to complete the assignment. For example, an assignment may be given that the instructor believes will require, say, four hours on the part of the average student. As a matter of fact, the time required by different students may vary from half an hour to eight hours (by no means an extreme case). When the papers are graded by the instructor the mark given depends principally upon the quality and quantity of the work submitted, without regard to the time required to prepare the paper (excluding mathematics or similar papers that are graded solely on quality). If two students of equal ability spend a different amount of time on the same paper, the one spending the most time usually receives the highest mark. This rewards industry, but penalizes the student who judges accurately the proper amount of time necessary for him to grasp the essentials of the assignment and prepare his paper. It also penalizes the student who is carrying a heavy course or is 'working his way', or is interested in student activities. On the other hand, under this system of instruction the slow student is not helped to increase his personal efficiency. If he spends enough time on the assignment he may receive as high a mark as anyone in the class, and even be graduated from the university with honors. When this man enters industry he may find himself hopelessly inefficient, simply because he has never been trained to do his work in a reasonable time.

Considering the case of the exceptionally bright student, the tasks set to the average student are so easy for him that he finds plenty of surplus time for other things, and, only too often, fails to utilize his spare time in improving himself mentally or physically. He learns to take life easy, and when called upon after graduation for steady and severe work he may be found wanting. I believe that the above considerations account for most of the failures of honor-point men in industrial life.

With all this in mind it was early recognized that a course in metallurgical analysis, to justify it before those who might think the subject of too practical a nature to be taught in a university, must emphasize the elements of time and quantity, and require a degree of accuracy commensurate with the needs of industry. Therefore, 24 determinations (12 in duplicate) were decided upon as a unit, and the laboratory arranged accordingly. In general, the student is not permitted to work with less than this number of determinations at one time.

Each student is given personal instruction on each detail of manipulation, and is given the time standard that he should be able to attain on each operation when he acquires proficiency. At first, he reports his own time on total operations for each lot of determinations. These reports are not likely to give less than the actual time spent, even if the student were dishonest (which is rare), because a minimum of 90 hours is required, regardless of the minimum number of determinations completed. After the preliminary clumsiness is overcome, stop-watch studies of each manipulation are made and the student is frankly told his relative position with respect to the standards, and where in each operation he has lost either

time or motion. Special training is given on those operations in which the student is below the average. Toward the end of the course an 'all-day run' is given, which consists of the following determinations:

Element	Number, in duplicate	Accuracy* % of element in assay	Method
Copper	3	0.5	Sulphocyanate-permanganate
Lead	3	1.0	Volumetric molybdate
Zinc	2	1.0	Ferro-cyanide
Iron	2	1.0	Stannous chloride reduction and permanganate titration
Sulphur	2	2.0	Nitric-chlorate solution and barium sulphate precipitation
Insoluble	1	2.0	From one of the iron determinations
"	1	2.0	From one of the sulphur determinations

*These are extreme limits of error, and are subject to decrease on certain samples. Note that the accuracy is expressed as "% of element in assay", not in terms of absolute differences in percentage. The day's work includes mixing of samples and cleaning of all glassware used.

In rating the student, inaccurate results are taken into account as follows: Divide the total time (less unavoidable delays) by the number of determinations (28); multiply this factor by the number of incorrect results, and add the product to the elapsed time. The result is termed the time-accuracy rating of the student. Credit for the course is not given unless this rating is less than six hours. The reaction-time for the determinations given, that is, the time required for complete reactions and safe manipulation by an experienced man, is about 4 hours 30 minutes for our laboratory conditions, including everything from mixing samples to writing the report and washing glassware. Improvements in equipment already installed or contemplated will permit a reduction of perhaps 30 minutes in this time. That the method of calculating the time-accuracy rating has some justification is indicated by the result of two runs made by the same student, giving 4 hours 51 minutes with seven errors at one time, and 4 hours 48 minutes with one error the next time.

TIME STANDARDS. By way of illustration, some of the most important standards established thus far and the minimum, maximum, and average observed time for each operation are given in Table 1. The figures are based upon motion studies made of six different students toward the end of their course. The relation between the average observed time and the standard is purely arbitrary. As each student is expected to equal or better the standard for each operation by the time he has completed the course, it would manifestly be unfair to set the standards as high as could be attained in a commercial laboratory, considering that the student is only required to spend the equivalent of 11 eight-hour days in the laboratory. On the other hand, the averages include many observations of students before they had reached their maximum efficiency, so that in general it is apparent that the standards can in most cases be placed below the averages, without injustice to the student. Therefore the standard time-intervals were chosen so that, in the opinion of the instructor, they could be attained by any student qualified for admission into the course (remembering that only graduate students are admitted) after proper instruction, and without spending an undue amount of time in the laboratory. Obviously, a great deal of work yet remains to be done to determine equitable standards.

During the period in which the studies were made the course was being given for the first time, and this method of instruction was just being developed. It is believed that as improvements are made in the laboratory and in the method of instruction, the unit time for many operations can easily be halved.

One of the interesting points brought out by these studies is the relation between filtering with one hand and with two hands. It is found that from 35 to 40% of the total time of pouring solutions from beakers into funnels is saved when both hands are used instead of one hand, without any apparent effect upon the accuracy of the manipulation. Consequently, the students are urged to acquire skill in simultaneous use of their hands in all cases of filtering where the nature of the precipitate does not require the use of stirring-rods for clean manipulation. The use of both hands applies to other phases of manipulation, such as transferring beakers on and off the hot plate and placing beakers under funnels.

It was ascertained early that considerable time could

Table 1—Observed and Standard Time of Various Laboratory Manipulations

No.	Operation	Minimum min.	Minimum sec.	Maximum min.	Maximum sec.	Average min.	Average sec.	Standard min.	Standard sec.
1	Mixing samples	0	30.7	1	14.2	0	57.0	1	00
2	Weighing charges	0	47.3	1	49.1	1	11.2	1	00
3	Adding acids from dispensing burette	0	02.0	0	06.4	0	03.76	0	03
4	Transferring beakers to hot plate, two at a time	0	01.0	0	01.9	0	01.45	0	01.5
5	Adding reagents with graduates	0	04.3	0	10.4	0	08.34	0	06
6	Transferring beakers from hot plate to tray with holder, one at a time	0	04.4	0	06.8	0	05.65	0	05
7	Folding filter-papers and placing in funnels	0	06.1	0	12.1	0	09.55	0	08
8	Wetting and fitting papers in funnels	0	02.2	0	09.9	0	05.1	0	04
9a	Pouring into funnels, with stirring rods, old rack	0	05.8	0	17.2	0	10.3	0	10
9b	Ditto, new rack	0	07.2	0	09.3	0	08.1	0	08
10a	Pouring into funnels, without rods, one-hand, old rack	0	06.0	0	09.4	0	07.18	0	07
10b	Ditto, new rack	0	06.4	0	08.1	0	06.52	0	06.5
11a	Pouring into funnels, both hands simultaneously, old rack	0	04.2	0	07.6	0	05.7	0	05.5
11b	Ditto, new rack	0	03.9	0	07.6	0	04.7	0	04.5
12a	Rinsing beakers into funnel with hose, old rack	0	10.6	0	17.5	0	13.52	0	12
12b	Ditto, new rack	0	08.5	0	14.8	0	13.02	0	12
13	Washing precipitates with hose	0	02.5	0	08.0	0	03.96	0	04
14	Washing precipitates with wash-bottles	0	04.5	0	10.3	0	06.63	0	06
15a	Titrating copper or iron with permanganate, first	0	34.0	1	21.8	0	56.6	1	00
15b	Ditto, duplicate	0	36.0	1	28.2	1	00.7	1	00
16a	Titrating lead molybdate, or zinc ferrocyanide, first	1	48.0	3	58.5	2	37.0	2	30
16b	Ditto, duplicate	0	38.5	2	41.0	1	31.5	1	30
17a	Gravimetric weighing, first	1	31.3	2	20.0	1	56.5	2	00
17b	Ditto, duplicate	1	02.1	1	51.8	1	23.7	1	00

Less than 25 cc. of solution was used on all titrations included in tabulation. Figures include reading and recording.

be saved by modifying the filter-racks in such a way that the beakers containing solutions to be filtered could be placed back of the funnels and on the same level. This saves from 1.5 to 2 seconds for each pouring. The rack has several other advantages, not at present capable of translation into time-units, due to greater convenience in handling the beakers on the rack and under the funnels.

Another point is the relation between the use of dispensing burettes and graduates for adding portions of liquids to the assays. A direct comparison was made of the two methods with the same manipulator, adding 20 cc. of solution, accurate to the nearest 2 cc. The results were as follows:

a	With graduate, each portion	4.6 sec.
b	With burette, each portion	2.5 "
	Time saved, each portion	2.1 sec.

By comparing *a* and *b* with No. 5 and No. 3 respectively in Table 1, it will be seen that the manipulator was faster than the average. The time saved with the burette would be much greater with a slower manipulator.

If it is necessary to fill the burette, the time required averages 22.3 sec., hence in this case there should be 11 or more assays in order to justify the use of the burette. If it is necessary to clean the burette, in addition to filling, this would add 34 sec., from which the time for cleaning the graduate, 12 sec., should be deducted, leaving a total of $(34-12)+22.3=44.3$ sec. Thus the burette would not save time unless it were to be used for over 21 portions. As cleaning and filling of dispensing burettes in a commercial laboratory is one of the duties of the wash-boy, it is, of course, best to use the burettes for all solutions in common use, and to limit the graduate to those solutions used only, say, 8 or 10 times per day. This is common practice in laboratories that are well equipped and efficiently operated.

It is not possible at present to compare the time standards obtained by observation of students with those attained in commercial laboratories. A rough comparison was made by the instructor, who has had considerable experience in commercial laboratory practice. It was found that one or two of the students were able to equal the instructor's time on most unit operations, but would always lose time referring to notes, making false motions, and other items occasioned by inexperience.

ALL-DAY RUNS. It was found convenient to plot the results of all-day runs graphically in order to compare the work of different students. By plotting several runs on the same sheet, or by the use of tracing-paper, the comparisons can be made quickly, and the minimum time of each stage readily observed. When better data are obtained in the future, it is thought that a differential chart, showing the variations of each operation from a predetermined standard, will be more suitable than the charts now in use, which show the actual time for each group of manipulations.

The charts, as well as a tabulated summary of the day's work for each student are posted on the bulletin board. It has been found that such publicity is a great incentive to those students who are slower or less accurate than the average to improve their work. From the charts and the tabulations, and by consultation with the instructor, the student can determine readily his weak points and focus his attention upon them when the next trial is made.

ACKNOWLEDGMENTS. I wish to acknowledge the helpful criticisms and hearty co-operation of Professors Theodore J. Hoover and James M. Hyde, not only in the preparation of this article, but also in the development of the time-study method of instruction in the laboratory.

Copper in Impure Sulphate Solution

By J. Ayrton Bradbury

*During leaching experiments on copper concentrate it was found desirable to devise a method of obtaining rapid and accurate copper assays on low-grade and impure sulphate solutions. It was essential that the method should be workable by manipulators with no chemical experience. The following was devised:

Pipette 10 cc. of solution into a 150-cc. beaker, add 5 cc. of 10% potassium iodide solution, stir occasionally, and allow to stand for about five minutes, until the precipitate of cuprous iodide settles. In cases of solutions containing less than 0.2 gm. copper per litre, a somewhat longer time may be necessary. Carefully filter through a 9-cm. filter paper, and wash twice with water to remove iron, cobalt, zinc, and magnesium sulphates. Place original beaker under the funnel, and pour over filter-paper 10 cc. of dilute (1:1) nitric acid, to dissolve the cuprous iodide precipitate. Allow to drain, wash once, but avoid undue dilution. Add 15 cc. (1:1 ammonia, transfer to colorimetric bottle, and dilute to the 35-cc. mark. Compare with standard scale of colors.

TO STANDARDIZE. To several lots of 10 cc. of impure solution, low in copper, add carefully measured quantities of cupric sulphate solution, sufficient to give amounts ranging from 0 to 2 gm. copper per litre. (Use a solution of cupric sulphate of which 1 cc. = 0.005 gm. copper, measuring from a burette.) Then carry each through the assay process, thus obtaining a standard set of colored solutions of equal bulks, namely, 35 cc. This method of standardizing necessarily removes errors caused by incomplete precipitation of cuprous iodide, although under the conditions of assay the precipitation of cuprous iodide has been found to be quantitative.

1. New standard colored solutions should be prepared whenever the constitution of the impure low-grade solution shows any great variation in analysis. Bottles containing standard solutions should be tightly stoppered.

2. Any greenish discoloration, due to the presence of ferrous salts after the addition of the ammonia, may be removed by oxidizing with a drop or two of hydrogen peroxide, followed, if necessary, by a second filtration. Such discoloration, however, should not occur if the conditions of assay are strictly observed.

3. Instead of applying the colorimetric test, the solution containing the ammonia may be titrated with dilute potassium cyanide solution.

*Abstracted from 'Chem. Eng. & Min. Rev.'

Air-Lift in Theory and Practice

By A. W. Allen

Introduction. The increased popularity of the air-lift resulted from an appreciation of its simplicity and economy, and from a better understanding of underlying principles. The earlier interpretations of the theory of air-lifting have been proved erroneous; the respect shown for such ideas in preliminary design led to inefficiency and to a decreased utilization of the system. The simplest form of air-lifting is the vertical elevation of water through a pipe or other suitable channel. It was considered for a long time that the actual elevation of the water was caused by the upward pressure of a jet of air, and that the greater the force of air applied through this jet the more effective the result. The acceptance of this idea as a fundamental principle on which the lift operated led to a wasteful use of power and an unjustified condemnation of the system. The variation in result and the contradictory opinions expressed as to efficiency led to experimentation and large-scale tests, and these, in turn, to the discarding of the theory. As an alternative it was submitted and substantiated that the lifting was caused by the decrease in the specific gravity of the fluid, by admixture with air; and it was then realized that economical results could be obtained only by making this admixture thorough, that is, by spraying the air into the water over as great a surface as possible, and by regulating the flow of liquid so that friction would be reduced to the minimum. The applicability of the system was extended, and a higher efficiency was obtained as soon as these basic principles were understood. It was found that a satisfactory return could be obtained for power expended. The simplicity and low first-cost of the equipment needed, and the elasticity of the system when in operation, were favorable factors.

Essentials for Air-Lifting. A primary essential for economical air-lifting is that the depth of the sump must exceed the height to which it is required to elevate the liquid. The ratio of height to submergence varies with the height to which the fluid must be raised; but, in the case of the majority of lifts, up to 100 ft. or so, it is usually 1 to 1½ or 2. If it be required to elevate the pulp or other liquid to a vertical distance of 20 ft., the sump, as the submerged part is called, should extend at least 30 ft. below the normal level of the fluid to be pumped. An ample depth of submergence, within obvious limits, is desirable; but the ratio is less in those cases where this is impracticable, and a decreased efficiency must be accepted as inevitable, or a compound lift must be erected. A fact that must be taken into consideration when depth of submergence is being considered is that greater depth means proportionately greater pressure of air. The system is so elastic that air-lifts often are used under conditions that lead to inefficient operation, and this, of course, is undesirable. A variation from the correct ratio is permisible, but any radical difference from the desirable proportions should be avoided.

Design of the Rising-Main. Given a satisfactory depth of submergence, the next consideration is the design of the lift-pipe, commonly known as the rising-main. In the simple air-lift this may consist merely of a length of pipe of suitable dimensions, delivering into the bottom of a launder or sluice. This method of disposal is preferable to the use of a bend or elbow at the top of the rising-main, which is liable to cause a re-compression of the air after the lifting has been accomplished, thus absorbing power and doing no good. Moreover, the vertical and open discharge gives prompt indication of the wastefulness of unnecessary pressure or volume of air.

Air is delivered by one of a number of available methods, the simplest being by means of a small pipe lowered through the lift-pipe, the discharge in this case being sometimes effected through the right-angle arm of a T-piece. This method of supplying air is a simple one, and is especially suitable in the case where a slimed pulp is being lifted, the solid in which might settle and choke an air-pipe if the latter were arranged to deliver in an upward direction. The initial pressure of air required is the amount needed to overcome the hydrostatic head, or the weight of the fluid at the lowest point of submergence; this is approximately ½ lb. per square inch per foot of depth of water, and proportionately more in the case of heavy liquids or pulps. This pressure, on account of the eductive action of the liquid being pumped, is reduced slightly as soon as operations are commenced. The air, as it rises in the lift-pipe, is increased in volume, thus accelerating the pumping action; when it reaches the discharge it should be allowed free egress and should meet with no restrictions. If no excessive pressure be used in the first instance, the air should escape at little above the pressure of the atmosphere; the discharge should be continuous and steady, rather than intermittent and jerky, the latter conditions arising from an imperfect mixture of air with liquid, or an excessive pressure or volume of air, all or any of which will result in poor achievement for power expended.

Elevating Solids by the Air-Lift. Solids, whether in the form of the sandy or slimy constituents of a fluid pulp, can be elevated effectively and economically by means of the air-lift, and under a wide range of conditions. In this connection it possesses two particularly favorable mechanical features: there are no moving parts, and no packing-joints to be kept clean. Centrifugal pumps are used largely for such a purpose and generally are preferable in those cases where no disadvantage ensues from the dilution of the pulp with additional water

or solution. In some instances, particularly after dewatering, it is inadvisable to permit dilution, and diaphragm-pumps are used. In other cases the air-lift has been found to possess advantages that are absent in other types of pumps; it is not to be recommended, however, for the elevation of pulp containing heavy particles that, under conditions of normal fluidity, might segregate and cause chokage. To obviate failure from such a cause, an excessive velocity in the rising-main is sometimes ensured by the use of excess air, but this procedure is to be deprecated. The air-lift is not universally applicable to all purposes of elevation, and it is as well to recognize this fact.

Elasticity of Air-Lift. For regular pumping from and to definite levels, next to the low first-cost and the fact that repairs and renewals are almost nil, the most favorable feature of an air-lift is its elasticity in regard to capacity. Temporary over-load may be met, within certain limits, by the increase in the volume of air; this, though not to be recommended in the case of continuous operation, may be considered as permissible in an occasional emergency for which regular and efficient provision would involve an unjustifiable expense. To arrange for the automatic control of both over-load and under-load, it is practicable to adopt a system whereby the supply of air depends on the height of the liquid in the sump, or submergence-pipe, from which the rising-main receives its supply. Fluctuations in delivery of material to the air-lift are adjusted immediately, and the amount of air used is regulated in strict proportion to the work done. This is a particularly advantageous feature where thickened sludge is being drawn from a number of settlers that are being tapped intermittently to permit of maximum dewatering. Minor fluctuations are likely in such a plant from time to time, and can be met satisfactorily without personal attention.

Summary. The advantages and disadvantages of an air-lift may be summarized as follows: It is suitable (1) in the case where it is practicable to sink or to otherwise construct a well or sump to a depth exceeding the height required to lift the material; (2) where compressed air is available or can be produced at a reasonable cost; (3) where a pulp containing fine sand or slime must be elevated and where further dilution is undesirable; (4) where aeration would be beneficial, whether from the chemical or from the physical standpoint; (5) where the supply is intermittent, and where there are advantages to be gained by the adoption of a system capable of automatic and economical regulation of power; and (6) where low first cost is a primary consideration. The air-lift is unsuitable, or should be adopted with caution, in the case where (1) the height to which the liquid must be lifted is so great that an abnormal depth of sump would be required, and where it would be inadvisable to construct a compound lift; and (2) where the material to be elevated contains solid particles of a size and weight that would involve segregation from the liquid in the absence of excessive agitation, resulting in chokage of the air-pipe, of the rising-main, or of both.

Manganese

Probably about 95% of the world's production of manganese ores, manganiferous iron-ores (using the term broadly), and manganiferous zinc residuum is used directly or indirectly in the manufacture of iron and steel, the small percentage of true manganese ore not so consumed being used elsewhere, states a bulletin recently issued by the Imperial Mineral Resources Bureau. The greater part of the ore used in metallurgy is consumed in the making of the ferro-alloys required for steel production (ferro-manganese, spiegeleisen, silico-manganese, and silico-spiegel); the remainder—consisting wholly of manganiferous iron-ore—is used for the direct production of manganiferous pig-iron. Self-hardening steels, made before the development of high-speed tool steels, contained from 3½ to 4% of manganese. Nickel-steels containing from 20 to 25% of nickel and 5 to 6% of manganese have been largely used, for many years, for electrical resistance-wires. The quantity of manganese consumed in the manufacture of manganese bronze, silver bronze, and other special alloys is relatively unimportant. The manganese bronze of commerce contains traces of manganese. The higher grades contain not more than 0.05% of manganese. The principal function of manganese in the ferro-manganese, or (as perhaps more usual in modern practice) the cupro-manganese added to the copper-zinc alloy, is to act as a deoxidizer. When ferro-manganese is employed, the small amount of iron thus introduced into the bronze is stated to increase appreciably the strength and toughness of the alloy, the most important use of which is in the manufacture of steamship propeller blades. Manganese dioxide is extensively used in the manufacture of dry-cell electric batteries, and for decolorizing glass—to which a slight amount of iron in the form of ferrous silicate gives a green tint. For decolorizing glass, from 2 to 15 lb. of manganese ore, of about the same high grade as that for dry-cell manufacture, is required per 1000 lb. of sand, a larger addition resulting in an amethyst tinge; if as much as 30 lb. be added, a black glass is produced. Manganese dioxide and salts prepared therefrom are extensively used as driers of paints in linseed or other drying oils, the quantity added to the oil being usually less than 0.5%. The dioxide is also employed in the manufacture of manganates and permanganates of sodium and potassium, used as disinfectants, for purifying various gases, and for other purposes. It has been extensively used in the manufacture of chlorine, but this gas is now obtained in the United Kingdom, the United States, and other large chlorine-producing countries almost entirely by electrolysis of either chloride of sodium or chloride of potassium. The dioxide is still used in some laboratories for the production of oxygen on a small scale. Manganese compounds are used to color glass, pottery, tiles, and bricks, in calico-printing and dyeing, and for certain paints (brown, green, and violet). Certain manganiferous ores from the weathered parts of silver-lead deposits are used as a flux in smelting lead and silver ores.

MISSOURI SCHOOL OF MINES CELEBRATES ITS SEMI-CENTENARY AT ROLLA

The fiftieth anniversary of the Missouri School of Mines was celebrated on November 4 and 5, by a football match, an alumni banquet, and an address by T. A. Rickard. The toastmaster at the banquet was Arthur D. Terrell of the class of '98. The speakers included the present Director, Charles H. Fulton, and two former Directors, L. E. Young (1907-1913) and A. L. McRae (1915-1920). E. J. McCaustland, Dean of Engineering, spoke for the University of Missouri. Professor George R. Bean spoke for the present faculty, and was received with marked cordiality. He represented the class of '90. W. Y. Bean spoke for the class of '78, W. S. Thomas for that of '94, R. P. Cummins for '05, Ray F. Rucker for '06, R. R. Benedict for '08, V. H. McNutt for '10, J. K. Walsh for '17. Philip N. Moore, past president of the A. I. M. & M. E., spoke eloquently for the mining industry in its relation to the educational system typified by the 'M. S. M.' The proceedings were marked by the affectionate regard of the alumni for their alma mater and the recital of happy recollections of student days at Rolla. Next day Mr. Rickard delivered an address on 'The Education of the Mining Engineer'. Dean McCaustland transmitted the greetings of the University of Missouri. The occasion was dignified further by the presence of Bishop F. F. Johnson and the Rev. H. Nelson Tragitt, who delivered the invocation and benediction respectively. An excellent band from St. Louis diversified the program. The Director of the School, Charles H. Fulton, presided.

"HOPEFUL BUT NOT SANGUINE", SAYS D. C. JACKLING OF THE OUTLOOK FOR COPPER

D. C. Jackling was interviewed recently at Salt Lake City regarding the outlook for copper. Although he declared that he was no more optimistic than in August, an undertone of confidence was noted in his attitude.

When asked when production would probably be resumed, Mr. Jackling stated that this depended entirely upon the rate of consumption during the next few months. As soon as the surplus was reduced to an amount that would be sufficient to meet average consumption of three to four months, operations would be begun again. That is, he explained, if the average consumption was 100,000,000 or 125,000,000 lb. monthly, production would probably be resumed when the surplus reached a point near 300,000,000 to 400,000,000 lb. This amount must be kept on hand because a period of three to four months elapses before copper matte can be shipped from mines to refineries and made available for consumption. Prices, when resumption is begun, Mr. Jackling believes, must slowly return to those levels at which the metal sold before the War. No great foreign production hangs over the American market, he stated.

MERGER OF COAL AND STEEL ENTERPRISES IS PLANNED

Negotiations in San Francisco are virtually consummated looking to the consolidation of the Columbia Steel Co., the Southern California Iron & Steel Co., and the Utah Coal & Coke Co. of Salt Lake City. Plans include the erection of a 500-ton blast-furnace in the vicinity of Salt Lake City for the smelting of iron ores obtained in Iron county; erection of a large coke-plant at Salt Lake City for by-products; development of the Utah Coal & Coke Co.'s properties; exploitation of the iron deposits near Iron Springs; working of limestone deposits near Salt Lake City, and the building of railroads to the new properties. In California it is planned to further enlarge the plants of the Columbia Steel Co. at Pittsburg and of the Southern California Steel company's properties.

Interested in the proposed merger are Wigginton E. Creed, of the Columbia Steel Co.; A. C. Denman, Jr., president of the Southern California Iron & Steel Co.; A. C. Ellis, Jr., president of the Utah Coke & Coal Co.; W. W. Armstrong, president of the National Copper Bank of Salt Lake City; and L. F. Rains.

BUNKER HILL SMELTER GETS ORE FROM BRITISH COLUMBIA

Lessees of the I. X. L. mine, at Rossland, B. C., recently shipped two tons of bonanza ore and 20 tons of second-grade ore to the Bunker Hill & Sullivan smelter, at Kellogg. The settlement on a former shipment of high-grade to the smelter at Trail, B. C., was made on a basis of 95% of the gold and silver content and $100 for treatment, which, considering the grade of the ore—183.66 oz. per ton—the shippers thought excessive. They therefore have sent the last consignment to the B. H. & S. smelter. The Florence Silver Mining Co. is shipping 400 tons of concentrate and crude ore to the Bunker Hill & Sullivan smelter, which offers more satisfactory terms than Trail. This has been made possible by the recent reduction in freight-rates. The Florence ore is low in silver, the average of the present shipment being 20 oz. silver per ton and 60% lead, and therefore cannot stand high treatment-charges.

CHIEF CONSOLIDATED COMPANY ACQUIRES CONTROL OF ADDITIONAL PROPERTY AT EUREKA, UTAH

The Chief Consolidated Mining Co. has acquired control of the Eureka Lily Mining Co. and the East Tintic Mining Co., both of which are situated in the eastern end of the Tintic district. The Eureka Lily property adjoins the Tintic Standard mine, while the East Tintic company owns two blocks of ground that are divided by the Iron King holdings. At the annual meeting of the Eureka Lily stockholders on November 5 a new board of directors was elected, four of whom are officials of the Chief Consolidated; they are Walter Fitch, Cecil Fitch, L. B. Cripps, and Thomas Carmichael, while the fifth director is R. J. Evans, former president of the Eureka Lily. Acquisition of these two properties is in line with the policy of the Chief Consolidated to enlarge its holdings so as to perpetuate the company. The Chief company has built up one of the most successful mine organizations in the State, and it is known that its officials have taken a keen interest in the eastern part of the Tintic district ever since the Tintic Standard first found ore in 1915. It is reported that the Chief company has a substantial interest, if not control, in the Apex-Standard prop-

erty, which is situated in the eastern part of this district. For the three months ending October 18, the Water Lily shaft was sunk a distance of 1106.8 ft., or an average of 368.9 ft. per month. The shaft is now down to a depth of 1250 feet.

ALASKA

Hyder.—The Premier Gold Mining Co., recently made a shipment of $15,000 worth of bullion, obtained from the second clean-up of the cyanide plant, and 200 tons of concentrate. The grade of the concentrate has not been announced, but if it runs as high as the last shipment the consignment should have a value of about $350,000. Some 25 men are working on the ore-bunkers, at tide-water, preparatory to putting the tramway into operation.

ARIZONA

Jerome.—The United Verde Extension Copper Co. has distributed the dividend of 25c. payable to holders of stock of record at the close of business on October 10. A statement that accompanies the dividend says that the forces at the mine and smelter are still at the minimum but that the copper surplus had been reduced during the past six months to 9,796,000 lb. Development work has been restricted and no additional ore-reserves worthy of mention have been uncovered.——A recent announcement made by Robert E. Tally, assistant general manager for the United Verde Copper Co., indicates that additional men are to be added to the 275 men that are now employed at the mine and the 200 at the smelter. This increase will be necessitated by the starting of construction on the $7,000,000 crushing and storage plant which will take two years to finish. The erection of the Cottrell plant is progressing and the smelter has been completely overhauled preparatory to resuming operations.

Kingman.—The No. 3 shaft of the United Eastern Mining Co. has reached a depth of 870 ft. and a station is being cut at the 850-ft. level preparatory to cross-cutting to pick up the vein. The shaft at the Big Jim mine has reached a depth of 670 ft. Pumps are now being installed and when this work is completed sinking is to be resumed.——The Tom Reed mill is handling better than 200 tons of ore per day. This production will be maintained for several weeks and will then be cut to 100 tons per day. The present policy will be to mill all ore that can be mined and milled at a profit even at the expense of reduced current tonnage. Recent work on the 400 and 600-ft. levels of the Aztec claim is reported to have opened some good ore. It is understood that development on the 700-ft. level has been disappointing although some good ore was found. The present high costs of mining make much of the Tom Reed 'ore' unprofitable; this was considered good ore prior to the War.

Recent samples taken from the Sunbeam mine assay as high as $40 gold per ton. The Sunbeam property, it is understood, was recently taken over from Messrs. Burt and Probasco by the W. J. Loring interests. Sampling at the mine is being continued preparatory to active development.

CALIFORNIA

Copper City.—Austen Bros., whose barium mine is near here, have closed a contract with San Francisco firms for 500 tons of ore per month, the product to be used in the manufacture of paint. An aerial tram carries the ore from the mine to the railway.

Engelmine.—All former records for production were broken by the Engels Copper Co. during October. Concentrate shipped contained 1,100,000 lb. of copper and 17,000 oz. of silver. According to E. E. Paxton, general manager, development in the lower levels of the mine are highly satisfactory.

Grass Valley.—According to T. R. Pell, plans for the consolidation of the Central Consolidated Mines, Inc., and the Norambagua property have been consummated. Some 2000 acres of mineral land will as a result come into the possession of the Banner Consolidated Mines, Inc., as the new company is called. The Norambagua property is three miles south of Grass Valley, and the Central Consolidated is northeast of the town. Neither has been operated for some years. John M. Nicol, of San Francisco, is in charge of operations.

The wage-scale agreement between the Mine Workers Protective League and four of the leading mining companies has been formally signed and is now in effect. It provides for a basic wage scale of $4.25 per day for machine miners and $3.78 per day for shovelers with extra pay for special work and for overtime. The companies signing the agreement are the Empire Mines Co., the North Star Mines Co., the Sultana Mining Co., and the Idaho-Maryland Mining Co.

Nevada City.—High-grade gold ore is reported to have been found in the east drift of the Red Ledge mine. C. C. Greenwood, superintendent, has been exploring the property for some months.

Central Colorado

Placerville.—The California State Railway Commission has ordered the Eldorado Water Co. and the Western States Gas & Electric Co. to deliver to the Pacific Channel mine, operated by John F. Sexton, 40 miner's inches of water for 24 hours every third day. This will permit operation of the mine one 8-hr. shift each day. It is expected that other mines in the vicinity will be opened as a result of the ruling. The question involved was the amount of water dedicated to mining use, and it was found by the Commission that, under the terms of the contract between the Western States and the Eldorado company, 200 miner's inches are stipulated to be for mining use.

Plymouth.—At the Plymouth Consolidated mine high-grade gold ore has been found in the small west vein on the 3225-ft. level. A raise is now being driven to connect with the 3050-ft. level. W. J. Loring expresses the opinion that operations from now on will return a profit.

Sutter Creek.—A. S. Howe, superintendent, reports that the work of sinking the shaft of the Central Eureka mine is progressing satisfactorily, that during the past week the shaft was sunk 16 ft. The contract, which calls for the sinking of the shaft 200 ft., will be completed within two weeks.

COLORADO

Blackhawk.—Returns received on ore from the Black Jack mine, shipped to the smelter by the Silver Mountain Mining Co., showed 0.27 oz. gold, 82.85 oz. silver, and 12.68% lead, total value $91.79 per ton. Another car from the Wheeler tunnel shipped by the same company gave returns of 0.32 oz. gold, 53.20 oz. silver, and 8.25% lead. The company has ore ready to ship at both properties and assays indicate a higher value in both consignments.

Boulder.—Lessees on the Caribou are shipping silver ore ranging from $100 to $1000 per ton; with a dozen lessees shipping, the 1921 production should show considerable increase.——Lessees on the Yellow Pine are shipping a good grade of ore and steady production will shortly start from the Potosi and Grand County mines.——Ore sampling 100 oz. silver is reported recently opened up at Salina; it is being prepared for shipment.

Breckenridge.—The Tymos, June Bug, Monte Cristo, and North Star properties have laid in supplies and will continue operating through the winter.——The dredges of the Tonopah Placers Co. and the Blue River Placers Co. will continue operations during the winter. A shipment of bullion was sent the U. S. Mint in Denver by the Tonopah company last week.

Cripple Creek.—Operations have been resumed on company account by the El Paso Consolidated company, and new ground is to be exploited below the 800-ft. level. A number of lessees are at work.

The Banner Gold, Henry Adney, and C. K. & N. mines, former producers and properties adjacent to the El Paso, have been leased to a company headed by Robert Hasty, a successful lessee of the district with outside backing, and as soon as the machinery is overhauled operations will start underground.

Denver.—Robert J. Grant, superintendent of the U. S. Mint, has been instructed from Washington to reduce the number of employees from 240 to 120 men. Two of the three shifts now employed coining silver at the rate of 225,000 dollars daily will be laid-off.

Durango.—The power-house, with electrical and compressor plants at the May Day mine, was totally destroyed by fire of unknown origin Sunday night, November 6. The loss is estimated at $10,000, insurance unknown. No plans have been announced as to re-construction. It had been planned to operate the mine during the winter.

Idaho Springs.—A new flume is being laid to the Mattie mine and, as soon as water can be turned in, development is to be commenced by a new company recently organized.

IDAHO

Bayview.—The owners of the Moonlight group have found rich silver ore that assays $120 per ton, besides some gold. There is said to be at least 100 tons of this rich ore.

Coeur d'Alene.—High-grade ore has been found on the property of the Lookout Mountain Mining & Milling Co., on Pine creek. The size of the body has not been determined, but a cross-cut to the vein disclosed 8 ft. of ore with the wall unreached. The ore is of smelting grade, assaying 30 oz. silver and 30% lead. The scene of the disclosure is at a depth of 300 ft., reached by a cross-cut 600 ft. long from which is a 130-ft. drift. A greater number of the stockholders are residents of Kellogg and employees of the Bunker Hill & Sullivan company.

The Water-Front at Hyder, Alaska

Pend Oreille.—The Clarinda Mining Co. has awarded a contract for the completion of tunnel No. 5 to the Lone Pine vein. The tunnel has been driven 1190 ft. and should cut the vein within the next 25 ft. Stringers, carrying chalcopyrite, have been cut in driving this tunnel.

MICHIGAN

Houghton.—The shipment, lake and rail, of 51,000,000 lb. of copper out of the Lake district between April 1, the date of the shut-down of the Calumet & Hecla and subsidiary mines, and November 1, compares with an estimated production during that period of 45,000,000 lb. This takes into consideration Copper Range, Quincy, Mohawk, Wolverine, and Calumet & Hecla refinery production. When the C. & H. mines closed, the parent companies and subsidiaries had on hand approximately 90,000,000 lb. of unsold copper. The other companies had comparatively small stocks. While Calumet & Hecla has reduced its metal surplus considerably, there still is an abundance of copper in the district, which accounts largely for the fact that there will be no resumption of operations by the Calumet & Hecla mines this winter. A production of 45,000,000 lb. during seven months is small

in comparison with the normal output for the district, which is in excess of 22,000,000 lb. per month.

The Quincy Mining Co. has opened a logging camp in a timber tract it owns near Hancock, which will give employment to a small crew of men until March 1.

The Copper Range mines are gradually building up their forces, making a net gain of 50 men in September and 40 in October. October production showed a small increase but not in proportion to the number of new men taken on. This is accounted for by the fact that it usually takes a little time to get stopes ready and prepare working places. With the gradual increase of forces, however, the Copper Range mines should show some gain in production each month from this time on.

At Ahmeek, extensive repairs are under way in No. 2 shaft, where the concrete skipway, which has crumbled in places, is being replaced with timber. It will require several months to complete this work.

A rather extensive program of drifting and stoping is under way in all four Mohawk shafts with the ore averaging 23 lb. per ton. Mohawk is using both level- and drift-scrapers with a large measure of success, the devices being particularly effective in the levels, where the cost of handling has been reduced almost 50%.

Bruce A. Middlemiss, a graduate of the Michigan College of Mines, is said to have worked out a process for the hardening of copper. He recently returned from Chile, where he represented the Guggenheim interests and where he conducted his experiments. With copper he uses 3% alloy. The product is declared to be ideal for automobile gears and similar parts. A patent covering the process, which is secret, is now pending. Tests have been made to show the hardness and toughness of the product and it is said several of the leading automobile manufacturers are interested and ready to place orders. Gears made of this copper are capable of withstanding great wear, it is claimed, and will not chip or break. Mr. Middlemiss has interested sufficient capital to build a factory for the manufacture of gears.

While a reduction of 25% in the freight-rate on copper bullion, ores, and concentrates, has been announced, this will have little effect here. There will be no reduction in the freight-rate on refined copper; beginning December 1, marking the end of the season of navigation, the all-rail rate will be 76c. per 100 lb., plus 3% war-tax, which will bring it up to better than 78c. The combined lake and rail rate is 49c., so a considerable saving is made on all copper shipped during the season of navigation. The metal can be stored in the East for as low as one cent per 100 lb. High freight-rates are still a large factor in mining costs. The price of steel and powder is still far in excess of the pre-war figure, but the difference is largely due to the freight-rates. Drill-steel has dropped slightly in price, now being 17c. per pound, while powder also has taken another drop, the present price being $15.05 per case, compared with $15.55 in September. Forest products have advanced 10% in price in the last 30 days.

MINNESOTA

Minneapolis.—Plans are completed for the construction of the new building of the Mines Experiment Station of the University of Minnesota. This plant will cost approximately $250,000 and is expected to be the most complete and well equipped ore-testing laboratory ever built. E. W. Davis is superintendent of the Station.

MONTANA

Butte.—The East Butte Copper Co. is producing around 1,500,000 lb. of copper per month and is earning a profit on its own operations outside of the treatment of Davis-Daly ores. Ore at the mill is averaging about 80 lb. copper per ton and the tailing from 2 to 3 lb. of metal. Blister copper is averaging 75 oz. silver per ton. Although East Butte orebodies are narrow, some of the cleanest mining in the district is being done, and when the new shaft is completed, about the first of the year, still greater efficiency is looked for, as on the deepest level of the Pittsmont property, the 1800-ft., ventilation is not good. The new shaft will permit the establishment of a direct current of air by means of raising and sinking. Gold extraction at the Elkhorn mill of East Butte is expected to be under way in a day or two as all the tanks have been filled with cyanide solution and crews have left Butte for the Elkhorn property. With cyanide somewhat cheaper than during the height of the War, it is believed East Butte will be able to make a profit on treating this ore.

North-Eastern Washington

NEVADA

Candelaria.—Work will commence within two weeks on the construction by the Candelaria Consolidated Mines Co. of a 300-ton mill at a cost of $200,000. C. D. Kaeding is general manager for the Candelaria company, while the Western Oil Purchasing Co. and the Rochester Silver Corporation are involved in the financing of the new plant. Candelaria is one of Nevada's famous old camps from which some $30,000,000 in dividends was paid prior to 1875.

Mina.—Everything is in readiness to try out the new mill of the Simon Silver-Lead Co. Representatives of the Minerals Separation company and metallurgists from the U. S. Bureau of Mines will be present at the initial run. A selective flotation of zinc and lead will be made, and the operation, accordingly, is of particular interest. Lawrence F. Barber has been engaged to take charge of the flotation work. The mill is connected with the mine by a rail tramway, over which ore will be transported by mule-trains.

This tram connects with the shaft at a depth of 30 ft. from the surface by means of a short tunnel. An ore-pocket of 250 tons capacity extends from the tunnel to the surface. Ore for the mill will be hoisted to the top and dumped into the pocket and loaded into cars by means of automatic gates. In the mine, ore-pockets of 100 and 200 tons capacity, respectively, have been provided.

Osceola.—Baird & Tilford Bros. has shipped another bar of gold bullion resulting from the milling of a small lot of $80 to $90 ore. The ore comes from an adit that has followed the vein for 240 ft.——The Marriott mill is also in operation on ore averaging $40 per ton in gold.

Pioche.—Since the completion of the repairs of the Bristol Silver Mines tramway 50 tons of Bristol ore have been carried over the mountain daily and, with the Black Metals mine also sending out a car per day, the outlook is good for the coming winter. The mines contributed to the tonnage shipped during the week ended November 12 in the following amounts: Black Metals, 365 tons; Bristol Silver mines, 225; Hamburg lease, 50; total, 640 tons.

Ore-Car Used at the Britannia Mine, Howe Sound, B. C.

Tonopah.—Two five-ton trucks arrived from Royston on November 8 with the first shipment of 10 tons of high-grade taken from the Betts lease on the Hudson estate, where the original discovery was made six weeks ago. The ore will be treated at the MacNamara mill, as it is the desire of W. H. Royston, manager for the Hudson company, to save the producers the transportation charge of $90 per ton to haul the ore by express to the Coast. The value of the ore is variously estimated but the silver minerals can readily be seen with the naked eye.

OREGON

Gold Hill.—The Millionaire and Gold Ridge groups, both three miles south from Gold Hill, are producing, each with 10-stamp mills. Other mines within a radius of five miles from Gold Hill, which are being re-opened and re-equipped, that will soon be producing, are the Sylvanite, Red Oak, Blossom, Lucky Bart, Roaring Gimlet, Corporal G, Braden, Bill Nye, Kubli, Nellie Wright, Alice, and Gold Hill Pocket groups.——The Sylvanite group two miles above Gold Hill on Rogue river, which was recently acquired by the Oregon-Pittsburgh Mining Co., is in charge of L. H. Van Horn. Plans for a 100-ton mill, a power-plant on the Rogue river, and heavier mine-equipment are being made. Material is being assembled to erect a large number of cottages and quarters for the employees at the mine.

The Manganese Ore Mining Co., of Terra Haute, Indiana, has just spent $100,000 in erecting a modern electrically driven dredge of the drag type. The company has laid a 3-in. pipe-line from Rogue river at Gold Hill, which is to deliver water pumped to the plant.

UTAH

Alta.—The ore-shoot recently opened at the Alta Tunnel & Transportation Co.'s property continues to improve, according to Herman Johnson, superintendent. The fourth lot averaged 46 oz. in silver and 40% lead, which is higher than the average of previous shipments. The ore averages 6 ft. in width at present.

Big Cottonwood Canyon.—The Big Cottonwood Coalition Mines Co. has purchased the compressor, transformers, etc., of the Iowa Copper Co. The company has also built about 400 ft. of snowsheds and purchased additional mine-cars. C. E. Robertson, secretary-treasurer, states that development will be hastened during the coming winter.

Eureka.—High-grade ore has been entered in a winze 50 ft. below the tunnel level at the Butcher Boy mine in South Tintic, by Davis and Presby, lessees. This property was formerly known as the Showers Consolidated, and is controlled by the R. J. and M. H. Walker estates of Salt Lake City. Eighty tons of ore, averaging 150 oz. silver, has been shipped, and a second shipment will be made shortly. ——Ore shipments for the week ending November 5 totaled 191 carloads, as compared with 168 cars for the preceding week. The Tintic Standard shipped 81 cars; Chief Consolidated, 39; Dragon, 15; Victoria, 15; Eagle & Blue Bell, 12; Iron Blossom, 11; Colorado, 6; Swansea, 7; Empire, 3; Gemini, 1; Sunbeam, 1.

Two new furnaces are being installed at the Tintic Standard Mining Co.'s mill. This will make a total of nine furnaces, with a total capacity of 200 tons of ore per day. It is believed the furnaces will be ready for operation December 1. E. J. Raddatz, president of the company, reports operating conditions at the mine and mill as satisfactory.

Milford.—The face of the adit-level being driven at the Galena Mining Co.'s property is now in a distance of 310 ft., according to Frank L. Osborn, who is in charge of the work. The Galena mine was a shipper of high-grade ore in the early days, but has been idle for some years.

Moab.—James S. James, superintendent of mines for the Radium Company, of Denver, announces that the recent curtailment of operations by his company in the Gateway district was caused primarily by the inactivity in the radium and vanadium markets. During the period of curtailment, the company will continue development work at its four mines, and also make needed improvements in the plants at Denver and Boulder.

M. I. Fowler reports that ore has been found in the Tornado group of claims, 18 miles east of here, at the north end of the La Sal mountain range. Work on the Tornado vein, at its intersection with an iron fissure, has resulted in opening ore assaying from $8 to $10 in free-milling gold, while some samples show as high as $200 per ton in gold. A copper-gold vein, 28 ft. wide, assays from $6 to $75 in gold, and from 6% to 25% in copper. A tunnel is being driven to connect the various workings of the Tornado group.——At the Panama Mining Co.'s property, 2 miles east of the Tornado group, development is being continued on the high-grade silver-copper deposit opened up some months ago, according to Fred McCoy, who is in charge of the work.

Park City.—Ore shipments for the week ending November 5 totaled 1979 tons, of which the Judge allied companies shipped 933; Silver King Coalition, 568; Ontario, 428; and the New Quincy, 50. Shipments the previous week totaled 2140 tons.

The second shipment from the new orebody at the New Quincy property totaled 39 dry tons and assayed 76.2 oz. silver, 19.2% lead, 16.3% zinc, and 37.2% insoluble, netting the company about $66 per ton. This is richer than the first shipment.

Salt Lake City.—An organization known as the Metals Extraction & Refining Co. has been formed by Salt Lake City and Ogden men to promote the Croner process for treating black sands. C. B. Croner, a Los Angeles mining engineer, is president. He states that his process has been demonstrated a success in recovering gold and platinum in placer mining, particularly in cases where the metals are in too fine a condition to be recovered by methods heretofore employed. Mr. Croner states that one plant is now in operation on the Snake river in Idaho, where his process is being used with satisfactory results, and that recently tests have been made in the experimental plant at Ogden on tailings. The process combines chemical and mechanical treatment.

WASHINGTON

Colville.—Operations have been resumed at the Old Dominion mine. A drift has followed silver ore for 14 ft. At the place of discovery the ore had a width of nearly 3 ft. and a metallic content that averaged $1140 per ton. This was at a depth of more than 700 ft. on the dip of the vein, and at a point 2200 ft. from the portal of the tunnel. Work was discontinued last September to permit the installation of ventilating equipment. This has been completed. W. H. Linney is general manager for the Dominion Silver-Lead Co.

WISCONSIN

Shullsburg.—The M. & P. Mining Co., operating the Pacquette mine, has made its first sale for the season to the American Metal Co. The ore is high grade. The Pacquette mine is fully equipped and a shaft is bottomed in ore. Production will now be steady under contract agreement.——The Rodhams Mining Co. has a force of men at work opening a new vein of lead ore recently discovered. The ore will be trammed overhead to the Rodhams mill. Sales were made during the month of lead ore amounting to several hundred tons, this going to the Federal Lead Co.

Day Siding.—The Vinegar Hill Zinc Co. is operating the North Unity mine with good results. Daily shipments of zinc ore are made to the National Separators. Sales of lead ore have been made to the Federal Lead Co. New ground is being drilled for the Vinegar Hill interests.

Galena.—The Burr Mining Co. has a small force of men at work under the charge of Watt Nolen, superintendent. New ground is being proved and the mill and mine equipment is being overhauled and put in shape to resume operation.

BRITISH COLUMBIA

Cranbrook.—Lynch Brothers, of Seattle, have been awarded a contract to explore the properties recently acquired by the Federal Mining & Smelting near Kimberley with a diamond-drill. A rig has been set up on the Federal claim, and Dan Lynch is superintending the work.

Hope.—The Liberator Mining Co. has purchased the stamp-mill and other machinery at the Lemon mine, near McKinney camp, and is transferring it to the Emancipation mine.

Nelson.—B. Cortiana has started a second tunnel at the Rampulo group, in the Lightning Peak district, which will give a depth of another 100 ft. on the vein. Cortiana has developed a good body of silver-lead ore at the surface and in the 400-ft. tunnel.——Andrew Johnston has packed 20 tons of ore from his property at Woodbury creek, in the Ainsworth district, to Kootenay lake, and shipped it to Trail. The last shipments from this property gave a return of close to $1000 per ton in silver and lead, but, owing to the depreciation in prices of metals the present shipment is not expected to bring much over $600 per ton.——The Railway Commission has reserved judgment in the application of the Great Northern Railroad Co. to abandon its Red Mountain branch and take up the rails, and suggests that it should come to an amicable agreement with the C. P. R. to take over the Rossland spur. The petition was opposed by the city of Rossland and by the Le Roi No. 2 Mining Co. C. R. Hamilton, attorney for the latter, stated that the mine represented an investment of $3,000,000, and would have to be closed if the railway were abandoned. E. H. McNeil, representing the railway company, offered to sell the spur connecting the mine with the C. P. R. for $3000, or give it to the mining company, at the option of the commission. It appears, however, that the line is too lightly constructed to carry C. P. R. engines.

Stewart.—John Hovland is shipping from his mine on Fish creek and Skookum creek. He expects to have about 20 tons of high-grade ore ready for shipping by the time the roads are in condition to transport the ore.——Clay Porter and George Mehlfield have been developing an 18-in. vein of galena, rich in silver, at the Idaho group, at the north fork of the Marmot river; they will ship between 20 and 30 tons during the winter. The ore has to be rawhided to the fork of the river.

Vancouver.—The Dominion Government assay-office gold receipts for the first ten months of the year totaled $2,569,976, compared with $1,808,970 for the corresponding period of last year. Though this included the production of the Yukon, as well as British Columbia, nearly half the gold output of British Columbia is refined in the United States, and consequently does not pass through this office. The-

receipts indicate that the gold production of the Province will show an increase of about 40% over that of last year.

MEXICO

Chihuahua.—John L. Ostrom has taken over the Cerra de Plata group of mines, situated in the municipality of Zaragoza. The property comprises 18 contiguous claims which produce silver, copper, and lead ores.——J. F. Carter, of Jimenez, has associated himself with Federico F. Nunez in La Doncella mines in the Boaz mountains of the Allende mining district, adjoining the Amargoza properties.——Adam S. Schaefer, of Parral, has added a number of new prospects to his holdings in the Parral district. Last week he filed with the mining agent application for titles to Las Recompensa group of six adjoining claims near El Nacimiento and Refugio mines in the municipality of Zaragoza. Schaefer has several other properties in this region which he is developing.——Francisco Villegas has also recently recorded a new group of mines known as the San Carlos with the Parral mining agency. They are situated in the rich Santa Barbara district.——Henry Muller, of Chihuahua City, has made some locations in the Santa Eulalia camp.

A general meeting of the stockholders of the Ahumada Mining Co. has been called to meet at the offices of the company in Juarez on December 5.——The Carmelita and Laura Mining companies will hold a joint meeting of shareholders in the City of Chihuahua on November 24 for the purpose of electing new officers and hearing the reports of the boards of directors.

ONTARIO

Howry Creek.—At the Bosquet gold mine situated in this district, 60 miles south-west of Sudbury, a vein from 2 to 6 ft. wide has been opened up for 2000 feet.

Larder Lake.—There is much activity in this district following the satisfactory results of the development of the Costello vein by the Crown Reserve and Canadian Associated Goldfields. The vein is 15 to 60 ft. wide and has a known length of one mile of which over half is on the Associated Goldfields property. The ore is of medium grade. Hundreds of claims have been staked in the vicinity. The Coniagas, of Cobalt, has secured 300 acres and a campaign of exploration has been undertaken. Practically the entire district between Larder Lake and Kirkland Lake, 25 miles distant, is now staked over a width of about five miles and prospectors are now looking for small patches that may have been overlooked.

Porcupine.—J. H. Black, manager for the Northern Canada Power Co., states that there is now enough water in storage to supply the Porcupine mines with power until the end of March. He intimates that negotiations are under way looking to a provision for the future needs of the camp.

The orebody found on the 7th level of the Dome Mines has been proved to be large. Diamond-drilling has indicated a depth of at least 150 ft., but owing to its irregular shape and uncertainty as to its dip it will need further development. A drift toward it is being run on the 8th level.

The new shaft planned by the Hollinger Consolidated will probably be started on the south side of the property comparatively near the boundary of the Vipond-North Thompson. A fact of material importance to the latter company is that the greenstone-schist formation in which the largest of the Hollinger orebodies occur is found to be dipping sharply south toward the V. N. T. property.

West Shining Tree.—The Kingston property consisting of three locations half a mile east of the White Rock has been purchased outright by an English syndicate for a sum stated at upward of $150,000.——Arrangements have been made for the re-opening of the Atlas, capital having been secured for the sinking of a shaft to a depth of 300 ft. and extensive lateral development. A force of men is being engaged.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

Glenn L. Allen is at Guadalupe, Zacatecas, Mexico.

F. M. Dancy has moved from New Orleans to New York.

Clarence E. Meissner has moved from Zacatecas to Mexico City.

F. S. Rawson has returned to San Diego, California, from Mexico.

William T. MacDonald is in southern California for about a week.

Cyril Williams, Jr., has moved his office to 369 Pine street, San Francisco.

F. G. Cottrell has been elected an honorary member of the Société de Chimie Industrielle.

Owen Letcher is on a tour through India, but expects to return shortly to Johannesburg.

C. W. Purington sailed on November 18 from Vancouver on the 'Tyndarius' for Yokohama.

H. B. Hart has been appointed research chemist for the Eagle-Picher Lead Co., of Joplin, Missouri.

F. H. Hamilton, who has been on a visit to Porcupine, sailed from New York on October 25 for London.

S. M. Soupcoff, mining engineer for the American Smelting & Refining Co., has returned to Salt Lake City from Colorado.

George W. Lambourne, president of the Judge allied companies at Park City, Utah, has returned to Salt Lake City from Chicago.

Edward R. Weidlein, of the University of Pittsburgh, has been appointed a director of the Mellon Institute of Industrial Research.

Edwin E. Chase and his son **R. L. Chase,** of Denver, have been in the Katherine district in Arizona, and have gone to Tucson on mine-examination work.

C. M. Gay and **Norman H. Gay** have reorganized their firm, which is now called the Gay Engineering Corporation, with offices at Los Angeles, as formerly.

F. C. Henriques, recently at the Bureau of Mines station at Berkeley, is now chief chemist for the Sampson Magnesite Co., Inc., at Sampson Peak, Mendota, California.

Henry T. Neal, manager in San Francisco of the purchasing department of the Metals Exploration Co., was married on November 16 to Miss Laura M. Miller.

George M. Douglas has returned to the Cananea Consolidated Copper Co., at Cananea, Sonora, Mexico, after having spent a year at Lakefield, Ontario, Canada.

T. H. O'Brien, general manager of the Inspiration mine, **P. G. Beckett,** assistant to the president of the Phelps Dodge Corporation, and **C. La Grande** have returned from Europe.

D. C. Jackling left San Francisco on November 9 for a trip of inspection to the Nevada Consolidated, Utah Copper, Chino Copper, and Ray Consolidated properties. He will return in about three weeks.

Charles T. Arkins, mining engineer, who some years ago was in charge of the Golden Horseshoe mill at Kalgoorlie, in Western Australia, and then went to London, where he acted as consulting engineer for the Broken Hill Proprietary Co. in the first lawsuit over the oil-flotation process, died at Los Angeles on October 21. He was for a number of years connected with the Allis-Chalmers Mfg. Co. and Fairbanks, Morse & Co., and while with them traveled extensively in Alaska and British Columbia. While in the latter country he acted in an advisory capacity on the feasibility of exploiting the goldbearing alluvium of the Yukon valley.

THE METAL MARKET

METAL PRICES

San Francisco, November 15

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.50
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$100
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

November 14.—Copper is active and strong. Lead is quiet and firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 8 Holiday		39.75	Oct. 3	71.07	42.89
" 9	67.62	38.75	" 10	70.73	42.06
" 10	68.12	39.00	" 17	72.97	42.57
" 11 Holiday		38.62	" 24	70.64	40.52
" 12	66.37	38.62	" 31	70.04	40.25
" 13 Sunday			Nov. 7	69.46	39.93
" 14	67.00	38.37	" 14	67.28	38.85

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Nov. 8 Holiday		Oct. 3	12.21
" 9	12.75	" 10	12.64
" 10	12.87	" 17	12.80
" 11 Holiday		" 24	12.69
" 12	12.87	" 31	12.68
" 13 Sunday		Nov. 7	12.75
" 14	13.00	" 14	12.88

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 8 Holiday		Oct. 3	4.70
" 9	4.70	" 10	4.70
" 10	4.70	" 17	4.70
" 11 Holiday		" 24	4.70
" 12	4.70	" 31	4.70
" 13 Sunday		Nov. 7	4.70
" 14	4.70	" 14	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Nov. 8 Holiday		Oct. 3	4.94
" 9	5.25	" 10	4.74
" 10	5.20	" 17	5.12
" 11 Holiday		" 24	5.14
" 12	5.20	" 31	5.07
" 13 Sunday		Nov. 7	5.18
" 14	5.25	" 14	5.23

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Oct. 18	47.50	Nov. 1	42.00
" 25	42.50	" 7	40.00
		" 15	40.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

THE SILVER MARKET

The following is quoted from the latest market letter of Samuel Montagu & Co., of London:

During the week movements of a somewhat sharp description have been recorded. On October 24 prices fell ¾d., and on the 25th a further penny, to 39½d. for cash and 38¾d. for two months delivery, the lowest prices recorded for six weeks. Yesterday they both recovered a halfpenny, and today a further ⅜d. and ¼d. for cash and forward delivery, respectively.

Many would be glad to know the reason for these changes, which are not heralded by any warning. To gain it, we must look below the surface, and reach the speculative forces which sway silver and many other commodities, as well as the foreign exchanges. For some time past no stable ground has been under our feet in the world condition of affairs. On the whole, some slight amelioration is taking place, but currency inflation, exaggerated prices for goods, and the legacy of unrest left by the War, afford great room for snatching profits—and also incurring losses—by gambling in any counters that are ready to hand. Among other commodities, silver has been selected for the purpose, and the fact that it governs, or is governed by the Far Eastern exchanges, renders it specially suitable: for it can be dealt in as a counterpoise to operations in the China exchange. Hence, given large unexpected sales or purchases upon a rather indifferent silver market, quick falls and rises in the price are only to be expected. Forecasts as to prices in the near future are therefore futile in the circumstances to which we have alluded.

India seems for the time being to have ceased acquiring the metal, and competition between her and China is therefore absent, but there appear to be two classes connected with China holding diverse views, and not infrequently they operate here either on the same day or some days not far apart. To them is principally owing the irresolution of the market. At the same time silver is being actually shipped to China.

We learn from a mail correspondent in Bombay that there was expected to be a good demand for silver after the holidays, provided the price was not too high, and that inquiry was disposed to languish when the quotation neared Rs. 100. As a matter of fact, the feeling in the Bazaars now seems to be bearish. The recent setback in the sterling value of the rupee, as well as their uneasiness about silver, are possibly not unconnected with a falling off in the Indian balance of trade, which is given officially as plus 93 lacs for September, as against plus 234 lacs for August. As regards exchange, however, the relation cannot be very intimate, for exchange is often fixed for months ahead, and not from day to day.

The Customs report of Yunnan, China, for 1920 throws interesting light upon the local conditions of currency. It states that the scarcity of silver caused prohibition of export of silver coins in 1919, and the prohibition was strictly maintained during 1920. Gold $10 pieces appeared in October 1919, and a $5 gold coin was put in circulation at the beginning of the year. Both these coins were in common use until the end of the year, when, the sudden fall in silver having increased their value, they soon disappeared from circulation.

MONEY AND EXCHANGE

Foreign quotations on November 15 are as follows:

Sterling, dollars:	Cable	3.97½
	Demand	3.97
Franc, cents:	Cable	7.30
	Demand	7.28
Lira, cents:	Demand	4.19
Mark, cents:		0.40

Eastern Metal Market

New York, November 9.

An optimistic tone pervades most of the markets and demand in most cases is fair.

Inquiries for copper are broadening and sales are satisfactory at firm prices.

The tin market is inactive, but prices are firm.

Quietness and steadiness rule in the lead market.

A spurt in values has been the feature of the zinc market.

Antimony is inactive and nominally unchanged.

Yesterday, Tuesday, was a holiday due to election.

IRON AND STEEL

Steel production in October was 1,616,810 tons of ingots by the 30 companies reporting, or more than double the 803,376 tons reported by the same companies in July. The increase in October over the September steel output was 37%, whereas pig-iron output in October was but 22% more than in September. The Steel Corporation's schedule this week represents 51% of capacity.

Railroad inquiry for rails for 1922, and what may be the beginning of better buying of cars, have appeared during the past week. Otherwise the chief developments in the steel market have been the letting of tin-plate contracts for the first half of next year and some good business in wrought pipe. Rail inquiries for next year include 100,000 tons for the New York Central, with a possible 200,000 tons, also 40,000 tons for the Norfolk & Western. The Pennsylvania Railroad is considering a 1922 quota of 150,000 tons. Thus far the leading interest has booked 120,000 tons of rails since the $40 price was named. Orders for 2500 cars for the St. Paul represent 29,000 tons of steel.

Though the upward turn in production came in July, further price deflation on the present movement is recorded for this week. 'The Iron Age' composite for finished steel now stands at 2.134c. per pound, or less than 27% above the average for ten years before the War.

COPPER

While prices as judged by the minimum price have not advanced, the market is much more active and firmer at 12.75c., refinery, or 13c., delivered, for electrolytic copper. A few sellers are offering at this level but there are other large producers who either quote at least ¼c. higher or are not quoting at all. Buying for both domestic and foreign account is distinctly better and inquiry is more voluminous. A feature of the latter is the interest in 1922 delivery. One company is reported to have purchased its 1922 supply, paying cash for it this year. Others are interested in first-quarter delivery. Significant is the estimate that sales for October amounted to 140,000,000 lb., while output of refined copper is not more than 40,000,000 lb. per month. Deliveries into consumption in October are not yet estimated, but up to that month they had averaged about 70,000,000 to 80,000,000 lb. per month.

TIN

A leading importer characterizes the market for Straits tin as almost stagnant. There was a little business in January-February shipment on November 3, but spot demand has fallen off. What inquiry there is centres in far-off positions rather to the neglect of the intermediate. Firmness in the pound sterling has been the sustaining factor so that the price of spot Straits, New York, has been firm to higher, the quotation on Monday standing at 28.62½c., New York, yesterday having been a holiday, due to the 'Tammany landslide'. The London market has been higher with quotations on Monday at £158 10s. for spot standard, £160 for future standard, and £159 per ton for spot Straits. Arrivals thus far this month have been 505 tons with 4450 tons reported afloat.

LEAD

Demand is steady at unchanged price-levels. Electrical, pigment, and cable interests are the most active buyers. Inquiries for future consumption are also good. Outside producers maintain their quotations at 4.40c., St. Louis, or 4.70 to 4.75c., New York, while the leading interest continues to quote 4.70c., New York and St. Louis.

ZINC

A rather unusual situation has been the feature of the market the past week. Unexpected buying by one or two interests, acting as dealers or buying to fill contracts, has caused a decided advance in quotations. Consumers have been only lightly interested. As a result of this demand from special sources prime Western for November or early delivery is now quoted at 4.75c., St. Louis, or 5.25c., New York, as a minimum, with but little available. Producers sold quite liberally into the November output and are not anxious for a large volume of business now.

ANTIMONY

The market is quiet and without feature with wholesale lots for early delivery quoted at 4.75c., New York, duty paid.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, are quoted by the leading producer at 24.50c. per pound, f.o.b. plant, but this is probably being shaded because the same grade from importers is available at 17 to 18c., New York, duty paid.

ORES

Tungsten: Stagnation rules and quotations are nominal at $2.50 per unit up, depending on the grade, delivery, etc.

Molybdenum: There are no features or demand with quotations nominal at 50c. per pound of MoS_2 in regular concentrates.

Manganese: The market is devoid of inquiry or interest with quotations nominal at 20c. per unit, Atlantic seaboard, for high-grade foreign ore.

Chrome: There seems to be no demand or interest with nominal quotations unchanged at $20 to $26 per net ton, c.i.f. Atlantic seaboard, for foreign ores, standard quality, depending on analysis, etc.

FERRO-ALLOYS

Ferro-manganese: The most interesting development is that the U. S. Steel Corporation has been a seller recently. While inquiry is light with only three 50-ton lots noted, the domestic alloy can be bought at $60, Pittsburgh, against a quotation of $58.35, seaboard, for the British. There are indications that domestic producers intend to make prices so as to hold their full share of the trade.

Spiegeleisen: The market is inactive with quotations unchanged at $25 to $26, furnace, for the 20% alloy.

Ferro-tungsten: No business is heard of with quotations nominal at 40 to 45c. per pound of contained tungsten in the case of the domestic alloy with the foreign quoted at 50c., duty paid, seaboard.

Ferro-silicon: A more active inquiry is reported amounting to 150 tons in the aggregate. A large Michigan consumer has bought 100 tons or one month's supply. Prices range from $55 to $60 per ton, delivered, depending on the seller.

Ferro-chromium: Regular standard alloy is quoted by one large producer at 14c. per pound of contained chromium, delivered, but there are indications that it can be bought under some conditions as low as 10 to 11 cents.

Company Reports

INTERNATIONAL NICKEL COMPANY

Report for the quarter ended June 30, 1921.

Financial: Earnings, $390,198.54; other income, $119,003.69; net income, $372,122.17; profits, $179,402.03; dividends, $133,689.

RAY CONSOLIDATED COPPER COMPANY

Report for the quarter ended June 30, 1921.

Financial: Operating loss, $85,619.35; plant shut-down expense, $289,994.04; miscellaneous income, $5403.87; net loss, $370,209.52.

Production: Copper contained in concentrate, 1,605,654 lb.; net production of copper, 1,546,535 pounds.

Remarks: Issuance of quarterly reports will be discontinued until operations are resumed.

MOUNT MORGAN GOLD MINING COMPANY, LIMITED

Report for the year ended May 29, 1921.

Property: Mines and plants in Queensland, Australia.

Financial: Total revenue, £1,038,682 18s. 2d; balance forward, £212,350 7s. 8d.

Production: 167,802 tons was treated in the concentrator for the production of 60,033 tons of concentrate. The smelter produced 5147 tons of copper and 76,463 oz. gold.

Reserves: 3,527,287 tons containing 2.57% copper and 6.04 dwt. gold.

SHATTUCK ARIZONA COPPER COMPANY

Report for the quarter ended June 30, 1921.

Financial: Development expense, $90,264.02; total expense, $94,926.72; net development returns and interest, $30,874.36; net expense for quarter, $64,052.36.

Development: 3265 ft. A new and important discovery of copper ore was made and is now being developed on the 600-ft. level near the boundary of the Roy and Leo mining claims in the north-east end of the property.

Production: Copper recovered, 152,578 lb., silver, 5397 oz.; gold, 22.34 ounces.

BENGUET CONSOLIDATED MINING COMPANY

Report for half-year ended June 30, 1921.

Financial: Receipts, ₱598,217.42; expenditures, ₱238,785.57; gross profit, ₱359,431.85; net profit, ₱283,984.15; capital distributions of five centavos each per share were made on March 31 and June 30, totaling ₱100,000.

Production: 18,904 tons of ore was treated for a return of bullion valued at ₱586,139.98.

Remarks: Development has been satisfactory; the item of propable ore in the last report now becomes positive ore, and a large portion of the possible ore becomes probable ore.

NEW MODDERFONTEIN GOLD MINING CO., LTD.

Report for the quarter ended June 30, 1921.

Property: Mines and plant at Johannesburg, Transvaal, South Africa.

Operating Official: E. M. Sharp, manager.

Development: 13,995 ft.; ore-reserves, 8,884,600 tons containing 8.4 dwt. per ton.

Production: 236 stamps and 14 tube-mills crushed 1,083,000 tons containing 9.96 dwt.; 6.424 dwt. per ton was recovered by amalgamation, and 3.317 dwt. per ton by cyanidation; residue contained 0.293 dwt.; theoretical as well as actual extraction by amalgamation was 64.5%; theoretical extraction by cyanidation was 32.7%; actual, 33.3%. Total actual extraction of gold amounted to 97.8%.

Financial: Total revenue, £2,969,198 2s.5d.; total working costs, £1,270,146 3s.4d.; working profit, £1,699,051 19s.1d.; dividends, £1,400,000; dividends to date, £7,433,750.

UTAH COPPER COMPANY

Report for the quarter ended June 30, 1921.

Financial: Net loss from copper production, $42,022.20; plant shut-down expense, $547,583.68; miscellaneous income, $145,367.21; loss, $444,229.67; distribution to stockholders, $812,245; deficit, $1,256,474.67.

Production: Copper contained in concentrate produced, 1,406,085 lb.; net production of marketable copper, 1,480,697 pounds.

Remarks: The issuance of quarterly reports will be discontinued during the remainder of the period of temporary suspension of operations.

CHILE COPPER COMPANY

Report for the quarter ended June 30, 1921.

Financial: Total income, $423,378.08; total charges, $1,533,411.46; loss, $1,110,033.38.

Production: Copper output, 12,001,873 lb.; ore treated, 335,871 tons of ore, averaging 1.75% copper.

Remarks: The above-mentioned loss of $1,110,033.38 includes the sum of $697,249.54 for depreciation, which is a book entry and is computed on a time basis, regardless of production or sale. The company had on hand on September 1, $8,813,000, representing cash and marketable securities, after setting aside $1,921,000 to complete the payment of purchase price of two tank-ships mentioned in the annual report.

KERR LAKE MINES, LTD.

Report for the year ended August 31, 1921.

Property: Mines at Cobalt, Ontario, Canada.

Operating Official: H. A. Kee, mine manager.

Financial: Expenses, $145,555.46; receipts, $195,820.26; dividends paid, $300,000; balance to balance-sheet, $178,979.51.

Development: 3341 feet.

Production: Shipments during the year amounted to 282,075 oz. silver.

Remarks: During the early part of 1921 an opportunity presented itself to acquire the Hargrave property adjoining the Kerr Lake mine. The ore taken from this mine has already returned the purchase price.

GREENE CANANEA COPPER COMPANY

Report for the year ended December 31, 1920.

Property: Mines and works in Chihuahua, Mexico.

Operating Official: T. Evans, general superintendent.

Financial: Gross income, $7,299,918.84; net income, $560,078.50; dividends, $500,000.

Development: 76,431 feet.

Production: The concentrator treated 288,176 tons of ore and produced 82,572 tons of concentrate; the smelter treated 782,989 tons of ore and concentrate; the yield amounted to 43,672,939 lb. copper, 1,778,617 oz. silver, and 10,089 oz. gold.

General: It was decided to join with the majority of copper producing companies in Arizona in subscribing to the capital stock of the Apache Powder Company. This plant is near Benson, Arizona, and is nearing completion.

AMERICAN SMELTING & REFINING CO.

Report for the half-year ended June 30, 1921.

Financial: Net earnings, before deducting administrative expenses and corporate taxes, $2,448,566.16; net income from current operations, before providing for bond interest, depreciation, obsolescence, and depletion, and after provid-

ing for all taxes, $1,919,015.51; balance after deducting depreciation and depletion, $1,001,837.71; balance before deducting dividends, loss, $1,101,831.49; net loss for period, $3,203,966.74; total profit and loss surplus, $22,783,325.91; dividends, $2,102,135.25.

Remarks: The dividend on the preferred stock is cumulative; the conservative policy of the management in the past having built up during more prosperous times a large surplus for such periods as the one the company is now passing through, the directors have felt justified in continuing the payment of the preferred dividend. All the properties of the company are in excellent condition; a slight improvement in general economic conditions is perceptible.

TEMISKAMING MINING COMPANY, LIMITED

Report for 18 months ended June 30, 1921.

Property: Mines and mill at Cobalt, Ontario, Canada.

Operating Official: G. F. Dickson, general manager.

Financial: Production, $179,294.67; administrative and general expenses, $366,539.47; deficit, transferred to surplus, $135,765.50.

Development: 1316 feet.

Production: 34,911 tons was milled for a total production of 243,029.2 oz. of silver.

Remarks: At the time that the mine was closed down through shortage of power in November last the price of silver was 70c. per ounce, which was sufficient to leave a margin of profit. The further fall since that date to about 60c. per ounce would be barely sufficient, even with the increased extraction from the tailing plant, to permit the continuance of exploration and development work. The mine, therefore, remains closed. The likelihood of discovering any appreciable quantity of high-grade ore in the old workings is small, but there is scope for developing a considerable tonnage of medium-grade ore that, under the improved conditions of working, would show a reasonably good profit with silver at 70c. per ounce.

ARIZONA COPPER COMPANY, LIMITED

Report for the nine months ended May 31, 1921.

Property: Mines, mill, and smelter at Clifton, Arizona.

Operating Official: N. Carmichael, general manager.

Financial: From copper production, £378,973 3s.11d.; working expenses, £543,320 15s.; net deficiency at May 31, £244,123 17s.2d.

Production: Ore treated at concentrators, 549,071 tons; ore smelted, 80,710 tons; copper produced, 18,550,000 pounds.

General: An arrangement has been made whereby the undertaking is sold to the Phelps Dodge Corporation, excepting the Edinburgh office, a sum of about £35,000, and the right to certain British tax recoveries. The price is: payment of the dividends on the 'A' preference shares and preference stock, and retirement of these shares and stock within five years; 50,000 fully-paid shares of $100 each of the Corporation, of which the capital will then be 500,000 shares of $100 each; the purchaser assumes all the liabilities, other than undisclosed contingent liabilities, not incurred in the ordinary course of business. The company is to have the right to nominate a director of the corporation.

UNITED VERDE MINING CO.

Interim report dated November 1.

The smelting works have remained closed, and in the mine only a small force of men has been employed on necessary work. Development work has been restricted, and no additional ore-reserves worthy of mention have been uncovered. Copper sales, at about 12c. per pound during the six months period in review, have reduced the metal in hand to 9,976,000 lb. In order to sell refined copper at present prices at New York, before production is resumed there must be a material reduction in freight-rates, not only on the metal produced, but on all commodities entering into its manufacture. It is hoped that such reductions may be secured in the near future. Arizona State taxes at present are prohibitive; for 1921 they are about $100,000 more than for 1920, and, in total, amount to more than two 25c. dividends per year. A dividend of 25c. per share was declared payable on November 1 to stockholders on record on October 10.

McINTYRE-PORCUPINE MINES, LIMITED

Report for the year ended June 30, 1921.

Property: Mines and mill at Schumacher, Ontario, Canada.

Operating Official: R. J. Ennis, general manager.

Financial: Earnings, $1,904,326.36; operating costs, $1,088,763.83; non-operating revenue, $272,951.91; net profit for the year, $815,530.12.

Development: 8281 ft.; diamond-drilling, 8464 ft.; ore-reserves, estimated, 624,422 tons, assaying $10.25 per ton.

Production: 171,916 tons was treated of an average value of $11.67 per ton. Bullion containing 91,330.26 oz. gold and 19,806.40 oz. silver was recovered.

General: It is stated that the increased quantity of carbonaceous ore in the mine made the problem of finding a successful method of milling of considerable importance. Experimental work and a study of the question has resulted in the development of a process that will treat satisfactorily the ore and without the aid of flotation. After a preliminary treatment in the ball- and tube-mill circuits the ore can be sent to the cyanide plant without danger of premature precipitation of gold.

Recent Publications

Oil-Camp Sanitation. By C. P. Bowie. Technical Paper 261, Bureau of Mines, 1921. 32 pp., ill.

Graphite in 1920. By L. M. Beach. II:10, U. S. Geological Survey, 1921. 7 pp. From Mineral Resources of the United States, 1920, Part II.

Phosphate Rock in 1920. By Ralph W. Stone. II:3, U. S. Geological Survey, 1921. 9 pp. From Mineral Resources of the United States, 1920, Part II.

Fluorspar and Cryolite in 1920. By Hubert W. Davis. II:9, U. S. Geological Survey, 1921. 16 pp. From Mineral Resources of the United States, 1920, Part II.

Arsenic, Bismuth, Selenium, and Tellurium in 1920. By Victor C. Heikes. I:7, U. S. Geological Survey, 1921. 22 pp. From Mineral Resources of the United States, 1920, Part I.

Gold, Silver, Copper, Lead, and Zinc in Arizona in 1919. Mines Report. By V. C. Heikes. I:16, U. S. Geological Survey, 1921. 40 pp. From Mineral Resources of the United States, 1919, Part I.

Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1920. Mines Report. By J. P. Dunlop. I:2, U. S. Geological Survey, 1921. 9 pp. From Mineral Resources of the United States, 1920, Part I.

The Mineral Industry of the British Empire and Foreign Countries. War Period. Cobalt. (1913-1919.). Imperial Mineral Resources Bureau, 1921. 22 pp. For sale by H. M. Stationery Office, Imperial House, Kingsway, London, W.C. 2, England. Price, 9d. net.

A Geological Reconnaissance of the Tucson and Amole Mountains. With Notes on the Southern Section of the Amole Mining District. By Olaf P. Jenkins and Eldred D. Wilson. By Milton A. Allen. Bull. 106, Geological Series No. 2, University of Arizona, Tucson, Arizona, 1920. 24 pp., index, ill., maps, diagram.

Book Reviews

Oil-Field Practice. By Dorsey Hager. 310 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $3.

A growing demand for a book dealing with American methods of developing oil properties has led to the production of the present volume, which is a companion book to 'Practical Oil Geology', by the same author. The facts and methods given in the present volume represent a compilation from authoritative sources, supplemented as far as possible by first-hand information. The author, in the first chapter, makes general observations and discusses historical data. The scope and the life of the industry are followed by speculations as to the future price of oil and future markets. Monopolies in the oil business are discussed, with particular reference to the Standard Oil group of companies. In the second chapter the question of the acquisition of oil lands is considered, with notes on royalties, titles, size of acreage, and other essential details. Development drilling is discussed in the next two chapters, followed by an analysis of production methods. Chapter VI deals with transportation, storage, and fires; and Chapter VII with avoidable oil-field wastes and losses. Refining methods are described and illustrated by means of excellent charts. The book concludes with a chapter on the elements of valuation and a useful appendix of tables and forms; it has been produced in a style that characterizes many useful handbooks issued by the McGraw-Hill Book Co., and will be found of value to all who are in any way interested in the petroleum industry.

Introduction to the Study of Minerals and Rocks. By A. F. Rogers. 527 pp., ill., pocket size, flexible. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

The author, who is Professor of Mineralogy at Leland Stanford University and an associate editor of the 'American Mineralogist', as well as the publishers, are to be congratulated on the appearance of a second edition of an attractive and reliable text-book on the subject. It was prepared primarily to cover a year's work in the study of minerals and rocks, and has been arranged for use both in the classroom and in the field. Part I deals with the chemical, morphological, and physical properties of minerals. Part II contains the description of 175 minerals; these include all the common minerals and most of those of any special economic, geologic, or scientific importance; large type is used to distinguish 56 of the commonest types. The order of the minerals is almost the same as in Dana's 'System of Mineralogy', except that the silicates are placed last. Part III contains an elementary discussion of the occurrence, association, and origin of minerals. This includes a brief description of some of the more common and important rock types and also of the prominent classes of veins and replacement deposits. Appended to Part IV there are two tables for the determination of minerals. A glossary of terms not explained in the text has been included in the index.

Determinative Mineralogy. By C. H. Warren. 163 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.

This manual was originally written and privately printed for use in the beginner's course in mineralogy at the Massachusetts Institute of Technology, where the author is Professor of Mineralogy. It is pointed out that there are several excellent text-books covering elementary crystallography and descriptive mineralogy that are satisfactory in these particulars. On the determinative side, however, they leave much to be desired. It was, therefore, in order to enable the student to supplement his descriptive textbook that this manual was compiled. Experience with its use, over a period of several years, has demonstrated that it gives satisfactory results both as an aid in the determination of the more common minerals and as a means of training the students in the systematic examination of mineral material generally. The contents are as follows: I. Use of the blowpipe. II. Simple tests for the elements. III. Tabulated list of reactions that are useful in determinative mineralogy. IV. Determination of minerals, use of tables, etc. Index.

American Chemistry. By H. Hale. 215 pp., ill. D. van Nostrand Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.

Chemistry is constantly becoming of greater importance in the life of the American people, and the realization of its value has been deepened during recent years. This situation, as the author points out, calls for a simple and clear statement of the more outstanding facts of American chemistry, which is the purpose of this book. It seeks to be of service both to the general reader and to the student still in school. For the latter it is intended for use either as collateral reading, together with a course in general chemistry, or as a short separate course. Two objects have been sought: to call the attention of the reader to the fundamental importance of chemistry to America, as well as to the wonderful chemical possibilities in America; second, to encourage in him the habit of reading articles in current literature that have a bearing on chemistry, to which frequent references are given. The record of the American chemist is one of achievement; it furnishes a real basis for future progress. The book is interesting and instructive. It deals with war chemistry; water and sewage; sanitation and medicine; food and fertilizers; textiles; coal-tar and dyes; fuel; silicate industries; paints and varnishes; rubber; electro-chemistry in industry; acids; metals; and American chemistry and the future.

Agricultural Geology. By the late F. V. Emerson. 319 pp., ill. John Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price, $3.

Geology and agriculture are closely related; indeed it is due to geological processes that hard rocks are broken down to soil, and essential mineral substances are set free that in some cases affect the physical qualities of the derived soil, and in others serve as sources of plant food. The student of agriculture, therefore, should have at least an elementary knowledge of the processes and principles of geology, with especial reference to the geology of soils and fertilizers. With this object in view, states Dr. H. Ries in a foreword, the late Professor Emerson prepared the present volume, but unfortunately his untimely death prevented his seeing it through the press. The subject matter and mode of treatment are the outgrowth of some years of experience in teaching geology to agricultural students; and although the book was prepared primarily for class-room use, it was also the author's hope that it might prove serviceable for reading and correspondence classes. On this account he endeavored to make the treatment as untechnical as possible, without sacrificing scientific accuracy. The book is excellently illustrated, and is a credit to the author and the publishers. The contents are as follows: Introduction. I. Minerals. II. Rocks. III. Weathering. IV. Residual soils from various rocks. V Wind work and eolian soils. VI. Ground-water. VII. Streams and their work; alluvial soils. VIII. Classes of alluvial deposits. IX. Soil creep; colluvial soils. X. Gla-

ciers and glaciation. XI. Lakes and swamps; lacustrine and cumulose soils; lakes. XII. Oceans. XIII. Mineral fertilizers. XIV. Soil regions in the United States. XV. Historical geology. Appendix; soil maps.

Motor-Truck. By V. W. Pagé. 962 pp., ill. Norman W. Henley Publishing Co., New York. For sale by the 'Mining and Scientific Press'. Price, $5.

As stated in the preface, this volume has been prepared to meet a demand from motor-truck owners, users, and drivers, especially those charged with operation and mechanical care, for a text-boox that would outline the principles on which trucks of various types operate. The treatise not only considers the construction and operation of all the leading types of gasoline and electric trucks, but also gives valuable data on systematic maintenance and cost control that will prove invaluable to those charged with the responsibility of operating truck-fleets economically and efficiently. Through the co-operation of the service departments of the leading American motor-truck makers, the author has been enabled to publish considerably more practical operating- and repair-data than are usually found in a treatise of this character, and also to present a series of informative drawings and photographs. The contents of the book are as follows: I. Motor-truck types. II. Motor-truck power-plant. III. Motor-truck fuel and carburetion systems. IV. Truck-motor cooling and lubrication. V. Motor-truck electrical-system. VI. Motor-truck clutch and gear-box. VII. Motor-truck drive-systems. VIII. Motor-truck chassis parts. IX. Motor-truck loading and operation. X. Special truck applications and body designs. XI. Road troubles and truck-maintenance. XII. Gasoline-truck repair, and adjustment. XIII. Electric-truck construction. XIV. Construction, care, and charging of truck-batteries. XV. Driving and maintenance. XVI. Truck operating cost determination.

Drawing Room Practice. By F. A. Stanley. 253 pp., 6 by 9, ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press. Price, $2.50.

It has been the observation of the author, who is the editor of 'Western Machinery World', that young draughtsmen, and even many shop-men of experience, find it difficult to visualize a piece of work yet to be completed in wood or in metal; in instructing such men in mechanical drawing it has been found desirable to put before them either a casting or a forging, representing the object to be drawn; or, where this is not feasible, as is ordinarily the case, to use photographic views that show the appearance of the work as it is to be when finished. The satisfactory results obtained have led to the gathering of a wide variety of material, together with actual working-drawings of such parts for use in specific chapters of the book, which deals with the making of drawings, from the simplest constructions to complete assembly and working-drawings of various classes.

The laying out of jigs and fixtures, punches and dies, and other special tools forms an important part of the work of the modern drawing-room; the draughtsman wishing to develop in his profession must familiarize himself with approved methods of showing such tools in his drawings. Systems of limits and tolerances for dimensions have already been adopted or are being adopted in the plants manufacturing parts in quantities; and here again many draughtsmen, even of wide experience, must add to their knowledge by a study of methods of limit dimensions adapted to their own particular line of work. The contents of the book are as follows:

I. Drawing Instruments and their Uses. II. Projection. III. Practical Applications of the Principles of Projection. IV. Development of Surfaces—Intersections. V. The Helix and its Application. VI. Screw Threads and their Conventional Forms. VII. Detail Parts—Sections. VIII. Parts and Sections of Assembly Drawings. IX. Working Drawings. X. Working Drawings of Small and Medium-Size Parts. XI. Tool Drawings. XII. Limit Dimensions of Drawings. XIII. Isometric and Oblique Drawings—Shop Sketches. Index.

America's Power Resources. By C. G. Gilbert and J. E. Pogue. 326 pp., ill. The Century Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.50.

This book is the result of an attempt to interpret the special, though generally unrecognized, importance attached to the resources of energy—coal, oil, gas, and water-power. The authors discuss the inefficient manner in which these are utilized. The material presented is largely the result of investigations that were carried on in the Smithsonian Institution, in the Fuel Administration, and in a somewhat diversified engineering practice, and brought out from time to time as special papers, emanating mostly from the Division of Mineral Technology, U. S. National Museum. "It is not," say the authors, "beyond the bounds of reason to foresee a condition whereby a householder, in place of his ton of anthracite, will receive a ton of smokeless coal without slate, a month's supply of cooking-gas, forty 'miles' of motor fuel, enough fertilizer to start a small garden, and tar sufficient to lay the dust in front of his house—all for far less money than he now pays for inferior coal." Municipal fuel plants are suggested. Discussing water-power, the author says that "it is cheaper for the user of energy to rely on the transportation facilities already at hand, employing them in the movement of the crude bulky material, than to provide himself with special facilities for the transmission of the refined electric derivative; but it does not follow because this procedure is individually cheaper that it is economically preferable. In the absence of railway facilities, for example, it would be decidedly cheaper for the individual consumer to haul his coal from the nearest mine than to build a railway for the purpose. Yet no one would think of arguing that reliance upon truck haulage would be preferable to the opportunities that would be afforded by railway transportation. The issue between electric transmission and railway haulage is precisely similar". The contents of the book are as follows: I. Human labor and mechanical work. II. The foundations of industrialism. III. Coal, the basis of national welfare. IV. Oil, the acceleration of progress. V. Natural gas, Nature's bonus to America. VI. Water-power, an unused annuity. VII. Smokeless fuel and civic progress. VIII. Power and industrial progress. IX. Three-dimensional transportation. X. The equalization of industrial opportunity. XI. Co-ordination and industrial evolution.

Graphical Methods. By W. C. Marshall. 245 pp., ill. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $3.

Graphic methods comprise all the methods of representing the relations of objects or facts by means of the relations between the lines of a diagram; all devices for representing by geometrical lines the numerical figures that result from the quantitative investigation of phenomena are included under the title. Graphic methods are employed to a large extent in physical investigations, as aids to calculation and for the purpose of exhibiting the nature of the law of variation of sundry phenomena. The principal use of these methods is to show the mutual variation of two quantities, as evidence by (1) the conveying of information, as when parallel lines of different length are exhibited that are proportional to the population of different countries or to the

population of one country at equal periods of time, and (2) to aid numerical or logical calculations, as when a curve is drawn through points whose co-ordinates represent the population of a country at successive decadal intervals, this curve being used to ascertain the population at other dates. We learn that there are three classes of graphic methods: (1) those that make no use of the continuity of space except to show that the extremities of lines are connected, (2) those that use only the projective properties of space such as drawings and maps, and (3) those that use only the metric properties of space and produce diagrams intended to be measured. Any quantity susceptible of mensuration can be represented graphically by a straight line, the length of which corresponds to the value of the quantity. Addition, subtraction, multiplication, and division of pure numbers are easily carried out graphically by means of lines; the application of this principle is found in the slide-rule. Graphic methods have great value in the interpretation of tables and the solution of formulæ, because of the ease of drawing a line, the cheapness of paper and pencil, and the skilful judgment of the human eye. The representation of quantities on paper is a convenient way of placing them before the eye and of comparing them. The simplest application is seen in the representation of tabular data, such as statistics. Engineering periodicals, technical books, newspapers, and text-books contain an endless variety of charts, good and bad, clear and complex, useful and useless. The word 'monography' means nothing to the average man, but it is of great importance in graphic chart-making; every technical man should know its possibilities, and be able to apply its principles. The present volume will serve as a means of instruction. The contents are as follows: I. Introduction. II. Kinds of graphs. III. Making of diagrams. IV. Applications. V. Determination of laws. VI. Routing and organization. VII. Calculations. VIII. Nomography. IX. Mechanical graphical records. Bibliography.

Waste in Industry. By the committee on the elimination of waste in industry of the Federated American Engineering Societies; with a foreword by H. Hoover. 402 pp. McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $4.

In January 1921, Herbert Hoover, as president of the Federated American Engineering Societies, named a committee of engineers to make a study of waste in industry. The report of that committee was duly presented a few months afterward; it is now re-printed in book form. It covers six industries—the building trades, men's ready-made clothing, printing trades, metal trades, boot and shoe manufacturing, and textile manufacturing. In addition to these six specific field studies, seven reports of a statistical character were prepared, each of them dealing with some aspect of industrial waste, or its elimination on an extensive or nation-wide basis; these form the third section of this report. As Mr. Hoover points out in the foreword, "We have probably the highest efficiency and ingenuity in the operation of our industries of any nation. Yet our industrial machine is far from perfect. The wastes of unemployment during depressions; from speculation and over-production in booms; from labor-turnover; from intermittent failure of transportation of supplies of fuel and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it". The contents of the book are as follows: Part I. Summary of detailed reports: I. Introduction. II. Sources and causes of waste. III. Recommendations for elimination of waste. IV. Description of questionnaire and evaluation. Part II. Engineers' field reports: V. Building industry. VI. Men's clothing. VII. Shoe manufacturing. VIII. Printing. IX. Metal trades. X. Textiles. Part III. General reports: XI. Unemployment. XII. Strikes and lockouts. XIII. Legal machinery for adjusting disputes. XIV. Industrial accidents. XV. Health of industrial workers. XVI. Eye conservation. XVII. Purchasing and sales policies.

Within the Atom. By John Mills. 215 pp., ill. D. van Nostrand Co., New York. For sale by the 'Mining and Scientific Press'. Price, $2.25.

This is another book by the well-known author of 'The Realities of Modern Science', who explains that it deals with theories as to matter and energy without mathematical formulation, emphasizing the granular structure and the electrical nature of matter and the apparently corpuscular character of energy. The reader need have no previous knowledge of electricity, mechanics, or chemistry. Some knowledge of electricity, however, is required for the appreciation of the evidence of certain critical experiments upon which modern scientists base their belief in electrons and in quanta of energy. To supply this in a quick and easy manner, the usual historical order of presentation has been abandoned, and the correctness of modern theories is assumed at the start. The electron and the proton are postulated; in terms of these the author then describes those few phenomena of electricity that are essential to the later consideration of the evidence. Thus is is hoped most rapidly to introduce the reader to modern theories as to the invisible workings of the physical universe. The following topics are dealt with: I. Atomic structures. II. Satisfied and unsatisfied systems. III. The Periodic Table of atomic systems. IV. Mass and inertia of atomic systems. V. Radio-active disintegrations. VI. Conduction of electricity through gases. VII. Conduction through solids, and other electrical phenomena. VIII. Proof of the existence of the electron. IX. Isolating a proton. X. X-rays and atomic numbers. XI. Photo-electric effects and the quantum of energy. XII. Light radiation and atom-molecules. XIII. Quantum hypothesis. XIV. Energy and its availability. An excellent glossary is appended.

Anuaria de Mineria, Metalurgia, Electricidad y demas Industrias de Espana, 1921. By Adriano Contreras, Roman Oriol, and Lois Oriol. Published by the 'Revista Minera', Villalar 3, Apartado 260, Madrid, Spain. 1010 pages. Not for sale in the United States. Price, 10.50 pesetas in Spain.

This is the twenty-first edition of a well-known directory, which has been compiled by an ex-professor of the School of Mines of Madrid. It contains a list of the mines of Spain, classified according to Province, together with the mining, metallurgical, electrical, and chemical societies in the country, with names and addresses of mining engineers and other information. It also contains details with regard to custom-house duties and commercial treaties. It will be found of value to anyone who is interested in the mining and metallurgical industries of Spain.

Silver Ores. By H. B. Cronshaw. 152 pp., paper. John Murray, Albemarle street, London, W. Price, 6s.

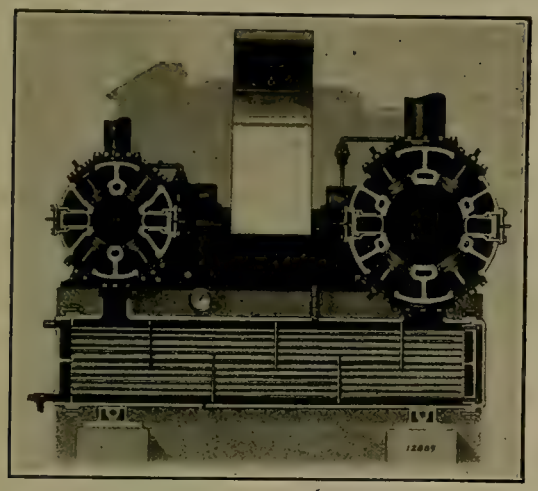
This is one of the series of monographs being prepared under the direction of the Minerals Resources Committee of the Imperial Institute. It consists largely of a résumé of the available information on the subject and will be found invaluable as a book of reference. The first chapter deals with silver ores, their occurrences, characters, and uses; then follows detailed descriptions of the character and locations of silver ores in all parts of the world, arranged in geographical order. A map of the silver deposits of the world is included, as well as a comprehensive list of references to the literature of the subject.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

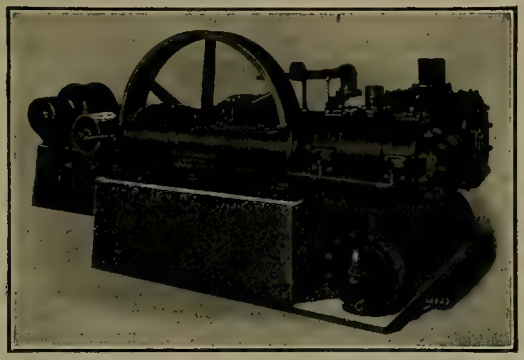
NEW TYPE OF BELT-DRIVEN AIR-COMPRESSORS

The Ingersoll-Rand Co. has announced a new line of belt-driven air-compressors. This type is known as the 'Imperial' Type 'XCB'; incorporated in it are several noteworthy features of construction, including Ingersoll-Rand plate-valves, for both the air intake and discharge, and the 5-step clearance-control for regulating the compressor's output.



Section Through Cylinder and Intercooler of 'Imperial' Type 'XCB' Compressor, Showing Clearance-Valve and Pockets

The plate-valves used in this compressor have been perfected after a most complete analysis of the light-weight plate-type valve. They include the features which have been proved necessary to the successful functioning of this type of valve, the most important of these being that the valve is supported throughout its entire operation in perfect alignment without any form of wearing guide—an essential feature in the life of the valve.



Ingersoll-Rand 'Imperial' Type 'XCB' Compressor with Short Belt-Drive

The clearance-control is a method of securing extremely efficient operation at part loads. Under average working conditions it is a well-known fact that the demand for air is seldom steady throughout the working day, and for this reason the performance of the compressor at underload is of primary importance.

With the clearance-control the compressor is automatically loaded or unloaded in five successive steps, these steps being obtained by the reduction or addition of clearance-space to the air-cylinders. The compressor will operate at full-, ¾-, ½-, ¼-, and no-load, and the design of the clearance-control is such as to secure efficient operation at any one step, the reduction in input-power required being practically in proportion to the reduction in output capacity.

The entire control is automatic. If the compressor is operating at full load and the demand for air falls off, this control automatically causes the compressor to operate at one of the underload points. When the demand for air is increased the compressor automatically assumes the load in successive steps.

An extremely valuable feature of the clearance-control is the fact that the clearance-pockets are made integral parts of the compressor cylinder and the entire regulation is obtained by the control of the volume of air taken in and compressed.

Another added feature of this control is the maximum-demand stop, which will prevent the compressor being operated at any higher maximum load than is desired. This can be adjusted so that the compressor will operate on a maximum of ¼-, ½-, ¾-, or full-load and, under conditions where the load-factor is comparatively low, it is of value in reducing the maximum demand, permitting a saving in the purchase of electric power—a feature found in no other type of control.

With the clearance-control, reduction in power required will be in proportion to reduction in output capacity. All the mechanism for regulating the compressor is independent of the compressor running-gear. The loading and unloading of the compressor is automatically accomplished in steps, the difference between any two steps being small enough to prevent any undue electric-current fluctuation.

This new type of belt-driven compressor, equipped with clearance-control can be furnished single-stage for low pressures and two-stage for higher pressures. The piston-displacement capacity for 100 lb. discharge-pressure ranges from 610 to 1505 cu. ft. of free air per minute.

'Imperial' Type 'XCB' compressors can also be furnished with the well-known short-belt drive-attachment with floating idler. This method of drive is now well known to all users of compressors, who acknowledge its advantages in saving floor-space, saving in length of belt, and permitting a greater arc of belt contact.

The Ingersoll-Rand Co. also announces its new Bulletin No. 3042, in which this new type is described in detail.

HAMMER-WELDED STEEL PIPE

The process of making lap-weld pipe by hammer-welding is relatively new as compared with the butt-weld and lap-weld processes, and the sizes made by hammer-welding are, relatively, much larger in diameter.

The pipe is made by bending a steel plate into tubular form with edges overlapping and then welding the overlapped edges, after they have been heated, by hammer-forging them on an anvil-block supported on a horn inside the pipe.

The process of hammer-welding is particularly well adapted to the manufacture of pipe in sizes from about 24 to 96 in. Due to the simplicity of manufacture—in that rivets, projecting ribs, and other objectionable features are eliminated—hammer-weld pipe has a relatively high efficiency. The strength and ductility of the material, the sound and smooth-welded seam, the simple and efficient types of joints that can be used, and other advantages make hammer-weld pipe particularly desirable for almost any purpose requiring large-diameter pipe.

With the addition of these larger sizes to the complete line of tubular products up to 30 in. diam., the National Tube Co. is now in a position to meet practically all wrought tubular requirements, with a total range of sizes from ⅛ to 96 in., inclusive, and can recommend the best type of pipe for each particular installation.

'National' hammer-weld pipe is adapted for practically all purposes where large-diameter pipe is required. Its larger fields of service are for water, gas, steam, and various types of pumping or power-plant installations. This pipe is particularly adapted to the higher-pressure requirements because of its dependable strong weld, its low-friction resistance to flowing liquids or gases, and to the fact that the hammer-forged weld is superior to any other form of jointing in its resistance to stresses caused by expansion, contraction, or other forces. Hammer-weld pipe is also adapted to the construction of tanks, shells, retorts, stills, digesters, receivers, etc. Bulletin No. 13, just issued by the National Tube Co., is a comprehensive treatise on the purposes and advantages of pipe of this character.

COMMERCIAL PARAGRAPHS

The U. S. High Speed Steel & Tool Corporation has developed the 'Eurekast' detachable rock-drill bit for which it claims 83% greater driller distance as compared with the standard bit of Swedish steel. The speed of drilling is not lessened. The bit is connected to the bar of steel by means of a threaded sleeve union; it is made of vanadium steel.

The Powdered Coal Development Corporation has been organized with headquarters at Omaha, Nebraska. This company controls the Pruden patents for the burning of pulverized coal in the western half of the United States. The company is actively engaged in financing and erecting central pulverizing plants and installation of equipment for burning pulverized coal. Byron B. Oberst, formerly with the Interstate Oil & Refining Co., is president of the new corporation.

The second official approval of a storage-battery locomotive for use in gaseous mines has just been issued by the United States Bureau of Mines to the **Jeffrey Manufacturing Co.**, of Columbus, Ohio. The approval covers a six-ton storage-battery locomotive, which may be equipped with a battery consisting of either 80 type A-8 Edison cells or 48 Type MV 21-plate Iron-Clad Exide cells. Caustic potash is specified as the electrolyte for use with the Edison battery.

Catalogue V-101, issued by the **Pittsburgh Mining Machinery Co.**, of Pittsburgh, Pennsylvania, describes and illustrates the company's centrifugal and disc fans for use in mine ventilation. A feature of the centrifugal fan is that no special cut-off is provided, required, or permitted to force delivery of the air. Delivery is obtained without such arbitrary device, by the scientific scroll of the housing, the shape of blades, and angle at which they are set. This fan with 10-ft. wheel is capable of delivering 300,000 cu. ft. of air at 5-in. static pressure or water-gauge.

The American Turpentine & Tar Co., of New Orleans, one of the oldest and largest producers of distilled pine products, will hereafter participate in the marketing of its products. Due to its location upon the Mississippi river, where freight-rates divide, the company is able to ship directly upon Western railroads, thereby expediting deliveries and greatly lessening freight-costs. For shipment to Mexico, South American, and Pacific Coast points direct steamship lines are available. Shipments will be made in tank-cars, barrels, steel drums, or cases containing two 5-gallon cans. A small booklet, called 'Destructively Distilled Pine Flotation-Oils', has just been issued.

The Bucyrus Co. announces the removal of its New York office to suite 728, 30 Church St., with E. G. Lewis in charge as Eastern sales-manager, effective December 1. Mr. Lewis has for many years been connected with the sales organization of the company both at Chicago and New York. M. J. Woodhull, who has had large experience in the manufacture and sale of railroad-construction equipment with the Bucyrus Co., is appointed Central sales-manager to succeed Mr. Lewis. He will be in charge of the Chicago office, 622 McCormick Bdg. E. R. Weber is appointed Northern sales-manager, at Minneapolis, 1224 McKnight Bdg., to succeed J. N. Gawthrop, who will become associated with Mr. Lewis in New York.

The Timken Roller Bearing Co., in line with its program of expansion, has just entered a new field—that of mine equipment. The salient parts of Timken bearings that have caused their universal adoption in front wheels as well as other points of hard service in automobiles, trucks, and tractors, appeal to mine operators as a solution of the wheel-bearing problem in mine-car service. Due to the tapered feature, the Timken bearing carries both radial- and thrust-loads and all combinations of both, and when, after long and severe service, wear develops, a slight adjustment eliminates it at once. These bearings have exceptional capacity per unit of space required for installation; therefore, are more economical than other types. The bearings are easily mounted in the wheels and ample space is provided for packing with lubricants so that mine-car wheels should not require attention for lubrication or adjustment for a period of from one to two years of hard service.

The Monroe Calculating Machine Co., Woolworth Bdg., New York, has just brought out a new model calculating machine to be made up in three sizes 12-, 16-, and 20-place capacity. This wide range supplies a machine for every need. Calculation with speed and practically without effort is made possible by the easy flexible crank-operation of the Monroe. The crank is short, smooth running, and turns with merely a slight wrist movement. Combined with the smooth easy turn of the crank is a feature making crank operation simple in the extreme. A forward or backward turn is completed at the same point, the natural position, and, although a wide leeway is allowed, the mechanism is absolutely locked againt error or change during the turn of the crank. When the work is done and the answer noted, no time is wasted in the clear-out. Simply a reverse turn of the small clear-out crank raises the carriage and clears the dials simultaneously. A forward turn clears the upper dials. Other features make for speed and accuracy.

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T. A. RICKARD, - - - - Editor

MR. ROY C. OSGOOD, in his annual address as president of the Investment Bankers Association, stated: "Business has turned the hardest corner in your experience and is pulling steadily on the upgrade". He ought to know.

EXCELLENT progress is being made by the Disarmament Conference at Washington. Our Thanksgiving this year will include a deep feeling of gratitude that the leaders of the nations have been restored to political sanity and are responding to the urge of public sentiment in every civilized country. All the trumpery memorials erected to the dead who died in battle will be superseded worthily by the recognition of the futility of warfare.

IN our last issue we published a short review on the report upon 'The Elimination [meaning prevention] of Waste in Industry' prepared for the Federated American Engineering Societies by a committee appointed by Mr. Herbert Hoover, as the first president of the federation. This report has been issued as a book of 350 pages, rich in facts of an informing kind. The most striking feature of the findings handed down by the 18 engineers constituting the committee is the preponderant share of responsibility for waste that is attributed to defective management. In the six industries that were studied the responsibility for waste "assayed against management" ranges from 50 to 81%, and averages 68%, whereas the proportion of responsibility imputed to labor ranges from 9 to 28%, and averages only 16%. That may be one reason why the directors of one of the Federated Societies, namely our own Institute of mining engineers, passed a resolution disapproving of the report of this committee.

TWO interesting points in mine taxation were decided on November 15 by Judge Page Morris, sitting in the United States District Court of Utah, in the suit of the South Utah Mines & Smelters Company v. Beaver County. The South Utah company, operating at Newhouse, in Beaver county, had accumulated prior to 1914, when operations were suspended, a large dump of copperbearing tailing from its concentrator. During 1918 the Utah Leasing Company earned net proceeds of $120,547 from treating a portion of this tailing in a flotation plant erected specially for that purpose. Pursuant to the provisions of an amendment to the constitution of Utah, passed in 1918, Beaver county in 1919 placed an assessment against the South Utah company, on a valuation of $361,641, or three times the value of the net proceeds of the leasing company for the preceding year. The South Utah company paid the tax under protest and started suit to have the assessment set aside. Two reasons for annulment were advanced: first, that the market-value of the property was not taken into consideration and that the procedure of determining valuation by using a multiple of the net proceeds was unconstitutional; and second, that the contract under which the lessee operated constituted a sale of the dump, and that accordingly any valid tax should be levied against the Utah Leasing Company. With respect to the second contention, the Court held that the contract merely gave the lessee the right to extract the metals from the dump in consideration of a stipulated division of any profits from such operations. Both questions were decided against the South Utah company. Although Judge Morris said that he had no hesitation in deciding the matter of constitutionality so as to uphold the basic law of the State, he recognized weighty arguments against the method of assessment, and suggested that the litigants might well take the case to the Supreme Court of the United States, in order to settle the point.

ON another page we publish some reminiscences of early days on the Comstock by Mr. Richard H. Stretch, who is now living at Seattle. Mr. Stretch is an octogenarian with mental faculties in good trim, as is shown by his delightful story of the olden time. We happen to know that he was born in Cheshire, England, and came to this country at the age of 24, in 1861. At that time his chief scientific interest was in insects; he was a keen entomologist, and he was eager to travel in new countries in pursuit of his hobby. So, in 1861, he went on a visit to an uncle in Illinois, traveling by way of New York and New Orleans. Two years later he joined an emigrant party bound for California, and won a reputation among the Indians because one of them had found a bottle that Mr. Stretch had lost containing insects in alcohol. When the friendly Indian saw other parts of his collection, he was greatly impressed and passed the word along that a Big Medicine Chief was on the way. This, it is said, saved the party from attack.

Mr. Stretch went to Virginia City and there began his connection with mining, as related in the article.

SUBSTITUTES are sometimes 'just as good' as the original; often they are expensive in the long run, regardless of the apparent saving in first cost. One of our readers recently recounted an experience in this connection. He was furnishing a newly acquired home. Having a bay-window in one of the rooms, he made the necessary measurements, purchased the fittings required, and sent to a local hardware store for two lengths of ⅜-inch brass rod to carry the window-curtains. The rod arrived; but in trying to bend it to conform to the angles of the window a great deal of difficulty was experienced. This led to an examination, which disclosed the fact that it was made of iron, afterward brazed. Several ineffectual attempts were made with home tools, the rods being sent finally to a local novelty-shop to be fashioned according to requirements. There they were heated to such a degree that the brazing was destroyed. It cost the victim 50 cents to have four right-angle bends made on the two light-iron rods, during which the appearance of the rods was spoiled, and subsequent loss and damage from rust were accepted as inevitable. The net result of the substitution of iron for brass was that a job was found for a mechanic, the hardware merchant apparently made an exorbitant profit on an article that gave no satisfaction, the victim was disheartened, and will avoid the use of metal in future for similar requirements. He had to pay an absurd price for the iron; the veneer of brass was valueless, for it had to be destroyed before the rod could be bent to the required angle. The total cost of the finished article was out of all proportion to the result. Is the Copper and Brass Research Association, before taking action, waiting for an improvement in the demand for copper and copper alloys? If so, it is making a big mistake. There is little hope of regaining the trade later if brass, at the present price of copper, cannot compete now with iron for the manufacture of a large number of articles. An educational propaganda is needed, but the public requires little advice or suggestion on the subject; it is the hardware dealer and the retailer that must be shown that they are 'killing the goose'. Those interested in the sale of iron are alive to the importance of intensive action; just now they are getting exorbitant prices for their metal in manufactured form, largely because the copper and brass dealers insist on even more exorbitant prices. There are drawbacks to the use of iron, but all of them are not insurmountable; non-corrosive iron has made its appearance; it contains chromium, as does the so-called 'stainless steel', although in smaller quantity; it is being used for the manufacture of a large number of articles previously made of brass. Unless the Research Association bestirs itself, the copper-mining industry when it resumes operations will find that serious inroads have been made into its prospective business by the substitution of cheaper materials during a period when concerted action should have been taken to familiarize the public and the dealers alike with the advantages of articles that are made of copper and brass. What is needed is a little less 'research' and a little more action on the part of the Association; perhaps a change of name would help; its aim is commercial, not scientific.

CONTRIBUTIONS to 'Discussion' in this issue cover a variety of topics. That the proposed revised mining law favors the large operator and discriminates against those who are interested in the search for and the development of mineral deposits is claimed by Mr. H. D. Phelps, of Prescott, Arizona. He cites other objections, and makes a plea for amendments and additions to the present laws, rather than the replacement of them by the proposed enactment. Relief for the gold miner, by means of the McFadden bill, is urged by several contributors. Mr. E. E. Putnam writes from Mammoth, Arizona, and mentions the sorry plight of a ite, vanadinite, and descloizite. Mr. Putnam says that was as productive to its owners as it was interesting to the geologist and to the mineralogist. The Mammoth is known to collectors for its beautiful specimens of wulfenite, vanadinite, and descloizite. Mr. Putnam says that many gold mines are being kept alive by the hope that the McFadden bill will be passed by Congress, and that, should this measure of relief be denied, these mines will be shut-down. He assumes that the present increase of interest in gold mining is due to the expectation of benevolent legislation, but in this we differ from him. It is our opinion, which we proffer in as sincere a spirit as Mr. Putnam does his, that the general public has discounted the prospect of such special legislation, and is becoming increasingly interested in this branch of metal mining because it realizes that conditions are becoming more favorable to it, in consequence of the fall in the cost of labor and supplies. The fixed price of gold is re-asserting itself as a factor favorable to the mining of ore deposits containing the standard metal. We deplore, with Mr. Putnam, the lessened use of both gold and silver, but we anticipate confidently that both will come into their own in due course, and that the paper currencies of Europe will be replaced eventually in large measure by silver coinages. We sympathize with Mr. S. J. Kidder, of New Mexico, in his reference to the use of gold in arts and manufactures, and the purchase of gold for such purposes at a price far below the cost of current production, but such anomalies and unfairnesses are common. We have paid 14¾ cents per pound for the paper on which the 'Mining and Scientific Press' is printed, whereas we used to pay 4 cents for paper of better quality before the War. Of the increase only a third is legitimate; the rest is profiteering; yet we do not expect Congress to legislate in behalf of ourselves and other publishers similarly circumstanced. The producers of war minerals were compensated because they prevented a shortage in response to the urging of the Government; the gold producers, as Mr. Kidder suggests, were in the same category; they also were told that their productivity was essential to the national pur-

pose. Presumably gold was not included among the war minerals because the market-value of it, in the United States, did not suffer by the termination of the War. In reply to Mr. J. S. Taylor, of Oregon, we can only say that the mining of gold is not superior to the law of supply and demand, although the operation of that law is obscured in this case by reason of the fact that the price of gold is fixed by law; nevertheless the market-value of gold in terms of commodities varies in accord with the supply and demand of those commodities. We venture to add our conviction that the whole intricate and vexatious question of gold as a standard of value is international in its bearings, and that the time must come when it will be submitted to an international conference. No single nation can legislate successfully on the subject. Mr. Alfred T. Fry makes interesting comments anent dry crushing in ball-mills, and submits screening analyses from which it may be inferred that fine powder remains in suspension in the mill and so escapes further comminution. This may be desirable in some instances, but in the case in point it was a disadvantage, for the problem was to crush the material so that only 5% remained on 150-mesh, and this was found impracticable, regardless of the time taken or of the conditions maintained in regard to load of pebbles or balls. Mr. Thomas French, a Canadian metallurgist, adds an interesting item to the known history of the cyanide process, with particular reference to the use of charcoal as a precipitant of gold from cyanide solution during the early days of the application of the MacArthur-Forrest invention.

Steel From Western Iron Ore

If negotiations now in progress in San Francisco are successful a new era in the development of Western industry is close at hand. Utah and California are particularly concerned; the plan is to form a $20,000,000 corporation in which will be merged a number of companies that control coal mines and iron-ore deposits in Utah, and two others that own and operate steel plants in both northern and southern Califorina. It is proposed to erect blast-furnaces at Salt Lake City and to ship the pig-iron produced to the Californian plants, where it will be converted into steel and rolled into shapes. More explicitly, the enterprise includes the following projects: (1) the increased development of the mines of the Utah Coke & Coal Company in Carbon county, Utah; (2) the erection of a large by-product coke-plant to produce the fuel for smelting iron ore; (3) the extension of the Sunnyside branch of the Denver & Rio Grande Western railroad to new coal beds that lie about four miles from the present terminal; (4) the opening and exploitation of rich iron-ore deposits in the Iron Springs district of Iron county, Utah; (5) the building of a 25-mile branch railroad to connect the iron mines with the main line of the Los Angeles & Salt Lake railroad at Lund; (6) the acquisition and enlargement of extensive quarries of limestone near Salt Lake City; (7) the construction, at the start, of a 500-ton iron blast-furnace near Utah lake, 25 miles south of Salt Lake City; and (8) the expansion of the existing steel plants of the Columbia Iron & Steel Company situated at Pittsburg, California, and at Portland, Oregon, and that of the Southern California Steel Company near Los Angeles. According to Mr. L. F. Rains, who represents the Utah interests in the negotiations, the States on the Pacific coast spend $150,000,000 annually for iron and steel products that are brought, mostly by rail, from the steel-makers and sundry manufacturers in the Eastern States. The steel plants on the Coast hitherto have confined their operations for the most part to the re-melting of scrap-iron for making new steel, and the re-rolling of old steel into smaller shapes; necessarily, the output has been limited, and most of the finished products used on the Coast have come from the East. Utah is endowed by nature with immense deposits of all the raw materials required for the production of iron. In the property of the Utah Coke & Coal Company alone there is estimated to be available 75,000,000 tons of excellent coking-coal; it will produce a coke that meets both the principal requirements for blast-furnace operation, namely, structural strength to resist crushing by the charge, and low ash-content. The extent and richness of the iron-ore deposits were proved long ago, but heretofore conditions have not warranted the construction of a railroad and the opening of mines. An assured market for a reasonably large production of pig-iron is all that is required to justify the investment of the capital necessary to bring together the coke produced from Utah coal and the iron ore from Utah mines. An assured supply of pig-iron and an adequate market for steel products is all that is necessary to justify the owners of the steel plants on the Pacific coast in enlarging their plants and commencing to make steel in earnest. The advantages that may be derived from the proposed consolidation are obvious. In the final analysis the success of the entire project depends upon whether or not steel can be delivered to the consumer in the West at a price that will permit successful competition with steel from Eastern plants. It will be necessary to convince the capitalists who are considering the financing of the undertaking that this can be done, or they will not be willing to invest their money. An important factor in determining the unit cost of production is the scale of operations; obviously, the Western steel-maker will be at a disadvantage on this score. The fact should be emphasized, however, that the availability of low-priced steel from Western mills will result inevitably in the establishment in the West, instead of in the East, of plants for the manufacture of building materials, machinery, and other equipment for which raw steel is an important requisite. This will increase the demand for steel, it will permit the expansion of the scale of operations of the steel-maker, and will reduce his cost of production; in other words, the disadvantage arising from the restricted production at the outset will be decreased gradually, when once the Westerner's operations gain momentum. It is possible that some of the details as outlined above will be changed; it may even be that obstacles will arise to prevent a merger under any conditions of the interests

mentioned; however, the development of Western resources of iron and coal and the establishment of a steel industry on the Coast are assured, even though they be postponed temporarily. It is to be hoped that the present negotiations will prove successful. They will mean increased employment, expanded business, and greater prosperity.

Institutes and Technical Journals

In the November bulletin of the Canadian Institute of Mining and Metallurgy we find a long and labored editorial discussing our recent reference to the relation between that Institute and the 'Canadian Mining Journal'. As the writer in the bulletin suggests, we wrote not without sundry side-glances at New York, that is, we recognized the bearing of the discussion upon the relation between the American Institute and the technical press of the United States, more particularly the oldest mining paper on this continent, the 'Mining and Scientific Press'. Our Canadian critic acknowledges politely the compliment we tendered upon the general excellence of the Canadian Institute's monthly bulletin and then proceeds to analyze the contents of that publication. We are asked if we object to half of it being given to papers presented at meetings of the Institute. No, we do not; but we suggest that as the papers are printed in the bulletin, it would be well to save money by not re-publishing them in volume form at the end of the year. Why not bind the bulletins instead?, The editorial comment in them is just as worthy of preservation as are the technical articles, and that is more than can be said for the editorials in the American Institute magazine. Next comes the current news of Canadian Institute affairs, which occupies a quarter of the reading matter in the bulletin. Again we have no fault to find; such news constitutes an essential part of the publication, of course. Then we are told that an eighth of the bulletin is devoted to a summary of news, and it is intimated that our animadversion is directed chiefly at this part of the publication. It is. The monthly publication of an engineering society has no business to trespass upon journalism, and the one in question would do so unsuccessfully if the 'Canadian Mining Journal' had not lost its prestige, largely because the bulletin is competing successfully against it, by aid of its subsidized status. We hasten to add, however, that the Canadian Institute sets an example to its American contemporary by charging a subscription of $1 per annum to its members for the bulletin. That is worthy of imitation, because it is both fair and businesslike. Some people would rather be businesslike than fair, but most people are willing to combine the two, thereby salving both their pocket and their conscience. In the last paragraph our friend at Toronto—we assume that he lives in that lively city—changes from a spirit of urbanity and goodwill into one of irritation and aggressiveness. He wants to know whether we meant to "damn" the bulletin "in its entirety from cover to cover". My dear Sir, abate your impetuosity. We went out of our way, as you have acknowledged, to say kind, but true, things about your bulletin; why then this petulent outbreak? However, we are always willing to answer a question, and as we are asked to state "in some future issue whether we [the gentleman at Toronto] are to read its [our] verdict in this sense", we say at once that we do think that the bulletin trespasses upon the function of journalism, which belongs to a technical paper—to wit, the 'Canadian Mining Journal'—and it does invade a field of activity not specified in its own constitution, as quoted in the article to which this is a reply.

Welded Pipe

The piping of natural gas to centres of population and industry is an evidence of a desire to utilize natural resources to the full and so to profit by the avoidance of waste. The practicability of laying considerable lengths of pipe, which will withstand high internal pressure, at a moderate cost has resulted from the wider adoption of the oxy-acetylene flame as a source of heat for welding. By employing an expert welder and with the aid of simple apparatus, it is now possible to construct, at comparatively low cost, a continuous pipe for the conveyance of gas or water. Mr. F. F. Doyle, one of the superintendents of the Midway Gas Company, describes, in a recent issue of the 'Mining and Oil Bulletin', the construction of 60 miles of 12-inch steel piping across southern California by this method, which would have a wider application were it better known. The following details may therefore be of interest to engineers engaged in other phases of the mining industry: The pipe used was of ¼-inch steel, lap-welded, and tested to 600 pounds per square inch. The individual pieces averaged 21 feet in length, and were beveled at the ends to ensure a satisfactory joint. As the pipe had to be buried after construction, a ditch was cut, 22 inches wide and 3 feet deep, part by machine and part by hand. A 'skid-gang' consisting of a boss and eight men, worked ahead of the welders, placing skids across the ditch and laying the pipes in position. The welding crew consisted of a foreman and 16 welders, each of whom was given two helpers. Each welder was supplied with a complete outfit, including a carriage for the cylinders of oxygen and acetylene, and sufficient hose to obviate the constant moving of equipment. Each joint was marked, so that defective workmanship could be traced to its source. The results were satisfactory, for only 59 leaks were discovered out of 8695 welds; 48 of these were from pinholes that were subsequently repaired by caulking; only 11 joints had to be re-welded. The work took 4½ months, an average of 1340 feet of line per shift being completed; each welder at the end of the day submitted a report as to the number of welds made, the amount of rod, acetylene, and oxygen used. The average was found to be 1.25 pounds of rod, 21.42 cubic feet of acetylene, and 23.6 cubic feet of oxygen per weld. Some of the welders were detailed to assemble sections of six or eight lengths of pipe; a 'tie-in' welder would follow who would join five of such sections; a second 'tie-in' welder would

finish the job. The junctions of the longest sections were always made in the early morning, when the pipe was cool and contracted. Eight ordinary welds, four to five angle-welds, or three 'tie-in' welds was considered a good day's work for one welder. The painting-and-lowering gang followed the welders; it consisted of a boss and 12 men. A primary coat of paint was first applied, allowed to stand for 24 hours, then covered by a coating of hot paint. The pipe was afterward lowered into the ditch by means of a tripod and chain-block; the ditch was then re-filled by means of a 'grader'. Motor-trucks were used to transport the men to and from a temporary camp, the framework for the buildings of which was fitted with plates and bolts, thus making it possible to move the camp a distance of from 10 to 12 miles in about six hours. Accommodation was provided for 130 men, the average number employed. The line is now in commission, under a pressure of 400 pounds per square inch; the work was thus brought to a satisfactory conclusion. There are many phases of mining and allied enterprises in which the use of a welded pipe would be practicable and where no disandvantage would arise from the need to dismantle at intervals. The strength of a pipe-line is at its weakest point; this is usually at a joint; a pipe of large diameter is often fitted with some type of packing joint, few of which are able to withstand continuous pressure without leakage. For obvious reasons the welded pipe will appear to have many advantages, particularly on account of saving in first cost.

Cyaniding at Virginia City

"Old-fashioned, but nevertheless the most satisfactory that we are able to devise." In words to this effect Mr. Walter L. Reid describes the treatment that will be used in the new 2500-ton cyanide plant that is now being erected by the United Comstock Mines Company at Virginia City. The company is a subsidiary of the Metals Exploration Company, which is headed by Mr. Bulkeley Wells; the enterprise consists of mining and milling at least 4,000,000 tons of low-grade ore and stope-filling from a number of old mines along the Comstock lode. The anticipated average tenor of the ore is four ounces of silver and one-tenth ounce of gold per ton, both metals being intimately associated with pyrite. Economical mining, made possible by block-caving and transportation through a new adit 9000 ft. long, is the first factor that is expected to make the enterprise profitable; the second is efficient metallurgy in a plant of large capacity now being erected near the portal of the adit. Mr. Reid, who is consulting metallurgist to the company, commenced his experimental work on the ore more than a year ago; although the design of the plant is now complete, some of the contracts for machinery have not been closed, and for that reason a specific flow-sheet is not available for publication. However, we are able, through the courtesy of Mr. Reid, to point out the interesting features of the treatment. Cyanidation of the raw ore entails the consumption of 3 pounds of cyanide and 18 pounds of lime per ton; for this reason in recent years the use of the cyanide process at Virginia City has not been accorded sufficient consideration in schemes for treating the ore. However, it was found that a large proportion of the deleterious constituents were soluble, and that a thorough wash with water would remove enough salts to reduce the consumption of cyanide to 0.8 pound, and of lime to 8 pounds per ton of ore. In the new plant the washing will be performed in rake-classifiers on material crushed to pass a ¼-inch opening. The slime from the classifier will be thickened in a Dorr vat, and further dewatered in a vacuum drum-filter, the cake from which will join sundry other slime products that will undergo agitation with cyanide solution. The filtrate will be discarded. Three procedures were open for the treatment of the coarse product from the classifier: (1) fine-grinding and bulk-treatment of the whole; (2) fine-grinding and concentration, followed by separate treatment of the tailing and of the concentrate; or (3) concentration followed by leaching of the tailing and fine-grinding and separate treatment of the concentrate. The first permitted the simplest flow-sheet; the fashion of the day suggested the second; but experiment proved that the profit would be greater by following the third plan. In detail the practice will be to pass the ¼-inch product with cyanide solution through a ball-mill for reduction to about 16-mesh; a rake-classifier *not* in closed circuit will remove any slime and leave a clean sand for concentrating. The tables will make four products: (*a*) concentrate, (*b*) middling, (*c*) sand-tailing, and (*d*) a virtually clear wash-solution. The last will be used to return the middling for re-grinding in the ball-mill; the sand-tailing will be leached, and the concentrate will be re-ground in a tube-mill in closed circuit with a concentrating-table, the concentrate or coarse product from which will be returned; the tailing or fine product will be given a continuous cyanide treatment in agitators alternating with thickeners. Slime from the final thickener will join the primary slime from the filter in the wash-water circuit for an additional treatment by agitation and thickening, the operation being concluded by final filtration in a vacuum drum-filter. There is nothing novel in the circulation and precipitation of the effluent leach-solutions, the overflow from the thickening-vats, and the pregnant filtrate from the vacuum-filter. Sundry special reagents will be used to stimulate and to accelerate the solution of the silver and gold in the concentrate, although no credit is claimed for having developed any mysterious or patentable process. The total cost for mining and milling is estimated at not more than $2 per ton. The foundations for the plant are almost finished and it is hoped to be ready to operate by the middle of 1922. The new town that has already started to grow near the site of the mill will be called Comstock, thereby perpetuating the name of the famous lode, along a few miles of which 39 mines were in active operation at one time during the 'sixties, and from which more silver has been taken than from any other equal area in the United States. The success of the project will be another

triumph for the resourcefulness and the ingenuity of the mining and metallurgical engineers of our day.

The Boston-Washington Power Project

The North Atlantic coast region of the United States was selected some time ago for a study of the possibility of centralized power production because of the extensive requirements of industries and railroads in that area. The work was entrusted to the U. S. Geological Survey, with Mr. W. S. Murray, of New York, as chief of the engineering staff. A report is now published. The proposal involves the construction of large steam-power plants at tide-water or on rivers where condensing water is available, and hydro-electric plants in those districts in the zone, or within transmission distance of it, where water-power can be utilized. After 1930, cheap power from the proposed St. Lawrence project and from additional plants at Niagara Falls may be available for western New England and New York State—a region that will benefit greatly by the development of these new sources of energy.

A double economy is sought in the proposed scheme—in investment and in operation. The outstanding feature is the establishment of a network of intercommunicating transmission-lines, by which one system will be made to take the place of a great number of small units. It is estimated that 970 miles of 220,000-volt and about 5000 miles of 110,000-volt transmission-line will be required, which will involve an enormous consumption of copper. The 1200 miles of lines that are now in operation, at 33,000 volts and thereabout, will become distribution-lines for public utilities. This scheme of transmission involves an expenditure of $104,000,000 by 1930; the total investment for the entire project up to that year has been estimated at $1,109,564,000, of which $693,218,000 would represent added capital, for existing steam-electric and hydro-electric plants valued at $400,000,000 would be retained in service. The territory between Boston and Washington represents only 2% of the area of the United States, but contains about 22% of the total population. The region has been described as a crowded workshop; it contains 96,000 manufacturing establishments, 76,000 of which during 1919 used power in excess of 12½ billion kilowatt-hours; nearly three quarters of this was generated by the companies concerned, mostly in units of small capacity and operating at low officiency, as compared with the standards maintained in the large central stations of the public-utility companies; it has been estimated that if the manufacturing establishments had been able to purchase power at standard rates, a saving of 13½ million tons of coal would have been effected. Assuming normal industrial growth till 1930, the complete electrification of the manufacturing and mining plants in the area would result in an annual saving of $190,000,000 to the industries concerned, over and above the fixed charges involved by an investment of $185,000,000 for motor equipment.

Railway electrification must be decided according to density of traffic; consequently it would appear that, of the 36,000 miles of main, branch, and side lines in this area, only about 19,000 miles could be electrified with a prospect of ultimate profit. This would cost nearly $500,000,000; but a saving of from 11 to 19% on the investment would result, or an average of 14%. Electrification is the solution of the problem of increased haulage at decreased cost; and in this connection it is interesting to note that an annual saving of about 9,000,000 tons of coal by the railroads would be accompanied by a considerable increase in the supply of available cars. No credit, in a material sense, is taken for the abolition of smoke, cinders, and noise, which would follow the substitution of electric- for steam-locomotives, but the average citizen appreciates the absence of these nuisances, even if his pocketbook is not affected thereby.

The scheme outlined is so ambitious that it will appeal only to those who are convinced that the industrial development of the country will continue without abatement. As we pointed out in a recent issue, statisticians estimate that, without the use of modern machinery, several billion slaves would be needed to keep the wheels of industry turning at their accustomed speed, and irregularly at that; but, although machines may duplicate manual labor, manual labor could not do the work that many machines perform today, however many billions of slaves were put to the task. Our material development is in the right direction; it is tending to reduce the need for manual labor; by taking full advantage of the discoveries of this age of electricity we can compete successfully with the products of cheap foreign labor. Mr. Albert B. Fall, the Secretary of the Department of the Interior, in transmitting the super-power report to the President, said: "I believe the engineering facts and economic conclusions here presented will command the attention alike of the financiers, railroad executives, public-utility officials, industrial leaders, and others of that group of our citizens of large vision who are building for the America of tomorrow. Our present-day achievements have largely come as a result of our country's unparalleled wealth in raw materials; the larger use of our sources of energy must be planned with every effort to avoid waste. Had the super-power project outlined in this report been in operation in 1919 it is believed that 25,000,000 tons of coal could have been saved; and with the rapid growth expected in the coming decade, the saving possible in 1930 by the interconnected electrification of industries and railroads would be 50,000,000 tons. However, these economies on a truly national scale will affect not only coal but capital expenditure as well, and especially the output of human energy. Moreover, cheaper electricity must surely add to the comfort and prosperity of our citizens". In this we concur, adding that the utilization on an adequate scale of the products of our metal mines, for the construction of electrical equipment and transmission lines, indicates one of the best investments that can be made by a country which hopes to maintain the lead in civilized progress.

Mining Law Revision

The Editor:

Sir—I have read with interest the many discussions of the proposed new mining law that you have printed. Permit me to make a few comments, with two or three suggestions of amendments and additions which I think might well be incorporated into our present laws, in place of the proposed new law.

The nucleus of the present mining law in the United States originated in 1849 in California. From time to time similar local laws were enacted elsewhere throughout the country; these differed somewhat in details, but in all cases they were designed to meet existing conditions, in fairness to the prospector and locator. The present mining laws are thus the outgrowth and development of years of practical application. Various questions arising as to their interpretation have been settled in the State and Federal courts, so that the present laws are now well understood.

The Government is interested in having the mineral resources of the country discovered and developed; for this reason it is right that the laws should be favorable to the prospector and to the small operator, so as to encourage exploration and development. A prospector who finds a lode of pay-ore should be entitled to it, and so should be allowed to stake and locate the lode as it appears on the surface.

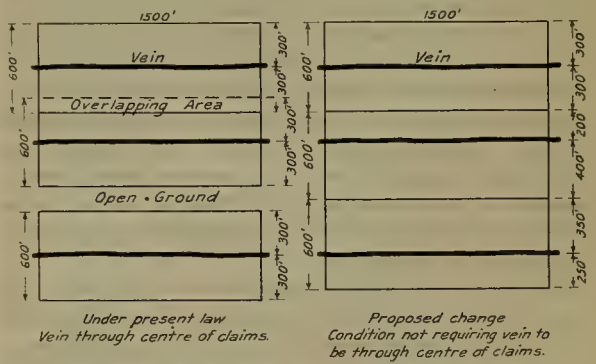
To make such radical changes of the mining laws as is proposed by the Arentz bill deserves the serious consideration of every mining man, senator, and representative.

Whether intentionally or not, the proposed bill unquestionably favors the large operator, and those interested in acquiring land, rather than those interested in finding and developing the mineral deposits. The Bill permits from 10 to 160 acres to be located and held up to 10 or 12 years without discovery and without requiring any development work. This will be detrimental to the development of the country's mineral deposits and will discourage the prospector who is earnestly in search of a discovery; it will cause mineral land, which otherwise might be opened up, to lie dormant and undeveloped. Furthermore, 160 acres is too large an area to be held by one discovery; there are places where this would cover the entire mineral deposit of a district, valued at many millions of dollars.

The proposed requirement that all mining claims must be patented within a period of seven years is unfair to the miner, who at present is able to keep up his assessment work and so hold his claim, but who has not the available cash to patent his claim.

The purpose of the present law pertaining to extra-lateral rights is to guarantee to the locator his right to mine the ore from the deposit he has found, and so long as it is a continuation of his discovery it belongs to him; that is the theory upon which the law of extra-lateral rights was established. No one can logically question the fairness and justice of this law; it has stood the test of time; it has caused considerable litigation, but this is not sufficient justification for its abolition. In fact, there would still be considerable litigation between claims located under the old law and the new proposed law.

I believe that there ought to be an amendment or an addition made to our present mining laws, allowing for the provisional location, protection, and holding of a claim, without discovery, so long as the holder diligently continues—by cut, shaft, tunnel, or drilling—the search for mineral upon his claim, and expends in labor and needed improvement the amount of $100 per annum per claim; such provisional location not to exceed a period of 5 years.



The present law with respect to the position of the side-lines (R. S. Sec. 2320) states that, "No claim shall extend more than 300 ft. on each side of the middle of the vein, at the surface, . . ." I would have this read that, "No claim shall exceed more than 600 ft. in width, between parallel side-lines, the locator to state the distance from the middle of his vein, at the surface, to his respective side-lines". This would permit a locator to take, say, 400 ft. on one side of his vein and 200 ft. on the other, or any distance so long as the total width did not exceed 600 ft., and would do away with the present necessity of centring the claim with reference to the side-lines, which is an objectionable feature when laying out a group of claims involving a series of parallel veins.

Under the present law there may be a gap between some claims, and an overlapping of others, whereas the veins could be located by a continuous group if it was not necessary to place the side-lines 300 ft. on each side of the veins; see accompanying illustration. I would further recommend that there be an addition to the present laws, requiring that the boundary monuments of a claim shall be designated and identified by giving the respective corner and name of the claim; as "N. E. corner of —— claim".

H. D. PHELPS.

Prescott, Arizona, November 3.

Relief for the Gold Miner

The Editor:

Sir—Being personally interested, as an owner of gold property, in all that pertains to the gold question, I have watched closely and have read carefully all the articles I could find on the subject.

It seems to me that all the writers are overlooking or neglecting very important points that should have full and intelligent thought. I have failed to see where any one has considered or mentioned the fact that, in view of the hope that conditions will get back to normal, but more in the hope that the McFadden Bill will be passed or that other legislation will again make operation possible, many low-grade properties have not been allowed to go to wreck, but, that, if their owners become discouraged in their hope and become convinced that no relief will come, those properties will be abandoned with further decrease in production of gold. These sustaining hopes have been the prospector's and miner's dream throughout depressing conditions.

I perceive that the present interest in gold mining is largely due to the belief or hope that the McFadden Bill will be passed; but the activity is only in the direction of being prepared and ready to reap the advantage when it comes; for, if legislation is to be only for temporary relief, as has been suggested, property owners would not lose any of the relief period in preparation.

I live in a little town that has its name and has had most of its support from the operation of a mine that has a record approaching fifteen million dollars in gold and molybdenum. That mine cannot be run at a profit under present costs and conditions; but even if it could, the owners would have no inducement to run. Why? There are two good reasons. First, the 65% above normal costs of production, would cover interest on the value of all the gold that could be mined during several years—that is the justification for waiting. Second, if legislation is to bring relief, the owners would not be justified in marketing their gold until that relief comes. The proposed bonus would cover interest and justify suspension for several years.

The legislation drags and the miner waits. Most of them are obliged to remain idle if their properties are of low grade. With a passing comment upon the declaration of Secretary Mellon, I submit my observations to be treated as your judgment dictates. He says that there is at the present date in the United States more gold than at any other date in history, and large amounts are still coming. Possibly, but questionably, this may be true; but is there not more beef, bacon, butter, and beans, and more corn, cattle, cotton, and copper, more peas, pigs, pork, and pumpkins than at any other date? Why should there not be more gold, and still more be needed?

I have been in business and postmaster in this place for thirty years. During all that time, until the last few years, gold was the cash kept as money in the house, and miners had their checks changed into gold. During the last three years I have seen but three pieces of gold. Those were held as presents or keepsakes. Circulation and shipments of gold have been restricted, with the result that it has been piled up, and up, and up, and now when Mr. Mellon sees the pile, he says it is bigger than ever before. Very true. Why should it not be? I also challenge his argument that a bonus would prohibit the use of gold in the arts. Mr. Mellon is probably a judge of jewels and precious stones, but I venture the assertion that beauty of appearance would not satisfy him unless he knew the intrinsic value was behind the choice. It is the intrinsic value of gold that sustains its appreciation in the arts. An abasement of its value would decrease its use, but a doubled value would double its appreciation and greatly increase its use. Before silver was demonetized and debased, the family carriage and driving harness had silver or silvered trimmings, and during those days a house-robbery was generally described by stating that the family plate and silverware had been stolen. Who prizes such things now? If the price of gold could be placed at ten times its present value it would be that much more in demand in the arts and that much more appreciated by those who could afford it. To be exclusive and have what the common class cannot afford is one of the aims and joys of the rich, and of those who would feign the appearance of being rich.

E. E. PUTNAM.

Mammoth, Arizona, October 28.

Dry Grinding in a Model Ball-Mill

The Editor:

Sir—It was desired to crush one sample of slag so that 15% remained on 150-mesh (I. M. M.), and another sample of the same material so that 5% remained on 150-mesh. Only a small quantity of the material was available; each sample weighed 3 lb. Lot *A* was ground by means of 74 flint pebbles, which weighed 22½ lb., for 230 minutes in a model ball-mill; the product was then found to contain 13.2% on 150-mesh. Lot *B* was ground for 340 minutes under the same conditions and was then found to contain 12.8% on 150-mesh, thus showing no better grinding in spite of the extra time. The flints were then replaced by 74 steel balls weighing 66½ lb. and occupying approximately the same volume as did the flints. Grinding was continued on the same charge for 126 minutes, a sizing analysis of the product then show-

ing 19.8% on 150-mesh. The balls were removed and 45 lb. of flint pebbles was substituted; grinding was continued for 120 minutes. A sizing analysis then showed almost the same result as that obtained in the first test when 22½ lb. of flint pebbles was used.

It may be that, in dry grinding, powder below a certain size remains in suspension in the mill and so escapes further comminution. In this instance it was noticed that the steel balls were too heavy for the purpose; the effect was much the same as that resulting when a piece of toffee is struck with a hammer; small clots of the material stuck to the balls. The final attempt with 45 lb. of flints apparently merely rubbed down the clots that had been formed by the balls. Thus by using the model mill, which was 16 in. long by 26 in. diameter, at 43 r.p.m., I was unable to crush the material so that no more than 5% remained on a 150-mesh screen. Screening analyses were as follows:

Product After Grinding

	Lot A	Lot B		
	230 min.	340 min.	466 min.	586 min.
I. M. M. screen	%	%	%	%
On 60-mesh	0.8	1.1	2.0	1.0
100 "	4.0	4.2	8.8	6.8
150 "	8.4	7.5	9.0	7.0
200 "	5.4	5.4	4.0	3.0
Through 200 "	81.4	81.8	76.2	82.2

ALFRED T. FRY.

Queenstown, Tasmania, September 23.

Surficial Closing of Fissure Veins

The Editor:

Sir—Generally the idea of increasing richness and size of veins of gold and silver ores, with depth, is akin to the lure which the other side of the mountain or range holds for the old prospector. The writer has noted conditions in a few places which do sustain the hope of a bonanza with depth; they occur with a peculiar phenomenon which suggests the subject of this letter.

A Mexican was sent to examine an old mine in northern Sonora, at which an inch or two of talc in a little seam was the only thing which the original prospector found at the surface; he found four feet of sulphide ore at the bottom of a 100-ft. shaft. Closer examination revealed the fact that the soft talc continued some ten feet; a few little lumps of sulphide ore of silver, with iron and copper, then appeared. These nodules and bunches increased in size with depth and so did the width of the streak. Approaching the ground-water level the streak became one foot, then two feet in width at 75 ft., and the ribbon of ore in the centre became continuous. At the water, where the talc practically stopped, the heretofore broken and poorly defined walls became solid and uniform and the entire fissure was filled with good ore. This was at 100 feet.

Chancing to meet the prospector and asking him why he had sunk when he had neither quantity nor quality at the surface (it being usually considered that one must have at least one of these two elements to justify sinking on a prospect) he answered, simply, that he had prospected some years in the district and had learned that a well-defined talc streak is all the showing at the surface, necessary to justify sinking, for such streaks almost invariably lead to ore.

The broken and loose condition of the rock at each side of the seam at last suggested a solution which is as follows: The country rock is silicious, a quartz porphyry, and is less soluble than the original vein-filling which had gradually dissolved. As it dissolved, the walls did what the sides of a shaft or drift do when the timbers rot away—they yielded to the lateral pressure and began to close.

In the case of failing timber-support the result, generally, is catastrophe; but in the silent removal of the ore by water during centuries of almost imperceptible action, the walls, though cracking and disintegrating, slowly moved toward each other until separated by the small streak of talc, and in some instances they came entirely into contact and sealed the top of the vein.

Sometimes masses of country rock had moved for twenty feet or more on each side of the vein and the little fissures or gash veins they left behind them had filled with clay and calcite; as these substances did not serve to weld the broken masses to the rock from which they had been loosened, the walls of a shaft would not stand without timbering. There was probably a secondary enrichment of the ore in place for a distance, until well below permanent water-level where the impervious character of the firm sulphides, not accompanied with much downward movement of water in the vein, made unlikely any change in the original character or grade of the ore.

Had the country rock been able to withstand the side-pressure when the vein-filling dissolved and took all support away from that side of the wall, the probabilties are that a filling would have been eventually substituted for the quartz gangue and sulphides, disappearing with the sinking waters, and a ledge of barren spar might have greeted the prospector of the present day. A shallow pit would no doubt have convinced the prospector that the spar never was mineralized beyond a few iron and copper stains, and he would properly enough have discontinued the search for ore. A similar phenomenon has been observed in at least two other places.

HORACE LOOMIS.

Choix, Mexico, November 1.

Charcoal and Cyanidation

The Editor:

Sir—Your editorial on 'Charcoal and Cyanidation' reminds me that my father, the late A. Gordon French, experimented with and used charcoal for the precipitation of gold from cyanide solutions soon after the introduction of the MacArthur-Forrest process. As far as I can recollect, he was carrying out some investigations on cyaniding, in barrels that had previously contained oil. The oil had been removed by burning, which left a coating of charcoal in the interior of the barrel.

Knowing that charcoal was commonly used for removing the gold from solution in the chlorination process, he

was led to try if it had a similar effect with cyanide. He used charcoal for this purpose, between the years 1894 and 1900, in Australia and New Zealand at several small isolated mines where cyanide could be obtained, but where zinc shavings were not so readily available. But what is more interesting, he wrote to me, about the latter date, that the vats used in cyanidation absorbed the gold to a certain depth, and this again led him to try the effect of sawdust. I do not recollect whether or not he found sawdust to be more efficacious than charcoal, but in later years I often saw him demonstrate the efficiency with which certain kinds of sawdust removed the gold from cyanide solutions.

THOS. FRENCH.

Welland, Ontario, Canada, November 4.

The McFadden Bill

The Editor:

Sir—In your editorial of October 22, referring to your interrogatory concerning the present condition of the metal-mining industry, you made some comment on the McFadden Bill which seems open to discussion. I refer particularly to the following:

"If any special legislation favoring gold mining is likely to be passed, it will be welcomed by those whom it will help, but many of them are honest enough to recognize the improbability, and even the impropriety, of such legislation, and are content to have the free market for gold maintained without prejudice."

Where an injustice has been done to an individual, a group of individuals, or an industry, even though done unwittingly, it should be corrected if possible. In 1915, the United States produced gold valued at $101,035,000, of which $37,820,000, or 37%, was used in the arts and manufactures. In 1920, the United States produced $49,509,000 in gold, while the arts and manufactures used $75,490,000, or 50% more gold than was produced in the whole country. To get this gold, they went to the mint and paid $20.67 per ounce for it, the same as they paid in 1915. In the meantime, the cost of producing gold and delivering it to the mint had risen enormously. The users of gold in the arts and manufactures had no limit placed on them by the Government in fixing the selling price of their manufactured articles, and they were consequently enabled to reap handsome profits at the expense of the producer. The latter was, in effect, penalized for producing gold during a period of high prices.

It is true that a premium on new gold may not be required to maintain the gold-reserve of the country and the McFadden Bill cannot be entirely justified on this ground. The gold-reserve of the country is being increased solely by the favorable trade position of the United States, it being the chief creditor nation of the world. Instead of using any of our 1920 gold production to add to the gold-reserve, there was in fact nearly $26,000,000 drawn from our reserve to supply the arts. If an actual "free market for gold is maintained without prejudice", is it to be supposed that manufacturers, under conditions existing since 1915, could obtain their gold at $20.67 per ounce, a price fixed by law when the general average price of labor and materials was supposed to be normal?

England has recognized the situation by the payment of a premium to South African producers, and to a large extent as a result of this premium, South African production in 1920 showed a far smaller percentage of decrease than did that of the United States.

The War Minerals Relief Act compensated producers of tungsten, manganese, chrome, etc., for their losses; why the impropriety of compensating the gold producers? Gold producers were urged to keep up their output and their employees were classed among the essential industries. It seems to be evading the question and not facing it to say that the difficulties facing the gold producers will gradually adjust themselves without government aid as deflation progresses and commodity prices return toward normal.

It would appear that the injustice done the gold-mining industry can, in a measure, be corrected by the passage of the McFadden Bill, and that Senator Oddie deserves full support in his attempt to convince the Secretary of the Treasury of this fact.

S. J. KIDDER.

Mogollon, New Mexico, November 3.

Taxing Gold Producers

The Editor:

Sir—In the questionnaire that you have addressed to mining engineers an important query has been omitted: Do you think it reasonable that mining corporations should be bulked with other corporations for taxation purposes?

The opposition to the McFadden bill seems to spring from the conviction that it is economically unsound to single out any particular industry for special treatment. The obverse of the argument is overlooked, that the gold-mining industry is the only one that is so singled out at present, in that its product is legally removed from the operation of the law of supply and demand and its price fixed regardless of the cost of production.

The yearly shrinkage in our gold yield should surely show our sapient legislators that some encouragement is needed if the industry is to survive. Why not put a flat rate of income tax of, say, 5% on profit over 5% on the capital invested in gold mining, whether it be a partnership or an incorporation? At present a company has to pay a Federal tax, a State tax, and a county tax. The last-mentioned, being levied on the capital value of land and plant, is often the most onerous of all. In addition to all these burdens a 15% corporation tax is to be imposed, just to encourage people to keep their money out of gold stocks, to please the faddists, and to drive one more legal nail into the coffin of the enterprise.

J. S. TAYLOR.

Rogue River, Oregon, October 29.

The Comstock Lode in the 'Sixties

By R. H. Stretch

When recently at Virginia City, Nevada, the editor of the 'Mining and Scientific Press' happened to see some of the maps of the underground workings on the Comstock Lode, made by me, and thereupon suggested in a recent issue that I put on paper some recollections of those early days. Hence this article.

Born in 1837, I unluckily began life too early—too early for this modern life—and the summer day in '63 on which I walked into the office of I. E. James at Virginia City and became his partner in less than an hour, though we had never seen each other previously, was the date on which I first went to school to learn something of the art of mining. My ability to do good 'lettering' gave me this opportunity. I had never handled a transit; I had never been in a mine; I had never seen metallic ores except as curiosities on the shelves of a museum, or gold, except as a coin and a rarity at that; but nobody was aware of the fact, because nobody asked me about it, in true Western fashion, and I soon discovered that I was not so badly handicapped as I feared. It was a strange community that foregathered on the slopes of Mt. Davidson, 6000 ft. in the air, with 40 miles of desert spread out before us, where life seemed to be limited to the 'dust-devils' that danced and curvetted to each other in the blazing sunshine. There certainly was nothing to distract our attention from the main industry of litigation! I had dropped into a community, professedly a mining one, but one in which the product of the mines went into the pockets of a brilliant group of lawyers, or into those of surveyors, experts, witnesses, and hangers-on, while the stockholders lived on the diminished dividends or on the fluctuations of the stock market. It was generaly supposed that every attorney in town who was not engaged to fight for a proposition was paid to keep his mouth shut. It soon became apparent, however, that knowledge acquired by burning the midnight candle into the small hours of the morning, might have a cash value though acquired at the cost of a damaged reputation; for in England in the '50s the individual who dared to even whisper that the world was more than 6000 years old, that all things were not made for Man, but that he was largely the result of his environment, and that the mysterious objects found in the rocks were not special creations, but the remains of animals that had lived and died thousands or even millions of years before the advent of Adam, was likely to be branded as an atheist!

In the '60s things were better. The natural sciences had gained a secure foothold, but deep mining, especially for the metals, as we now know it, was in its infancy in America. A start had been made in California, for the outcrops of the veins on the Mother Lode were so bold and easily traceable that no serious or puzzling geological problems had been encountered to call for legal aid in their solution. There were no National or State laws governing the location of mining claims. When a new district was discovered the miners made their own law to regulate the length of the claims and their lateral limits; it was usually a declaration that no parallel location could be made nearer than a given number of feet from the one already located. What this distance was on the Comstock I am unable to recall, but it was probably more than the 50 ft. in the camp of Aurora, some miles to the southward. The result of this custom in a region four miles long, striped with innumerable mineral stains and outcrops for more than a thousand feet east of the intermittent white quartz outcrops on what appeared to be the western limit of mineralization, can be easily imagined. When it was learned that the black sludge in the sluice-boxes of the miners at the north end of the district was worth thousands of dollars per ton, a wild era of staking followed. Every mineral stain showed a location notice, so that when I wrote the story of the Comstock at the request of Ross Browne, for the Government in the first issue of the 'Mineral Resources of the West', I found, in reply to one of the questions asked, 39 mines in active operation and more than 5000 locations on record in the Virginia City, Gold Hill, Silver City, and American Flat districts! No wonder that when the 'one-ledge' theory was proved correct there were hundreds of suits on file that died sudden deaths. The present 'apex' troubles are as nothing compared with ours, for it soon became apparent that the bonanzas were few and far between, and that there was no clean-cut fissure on which they were strung as beads on a cord; there was no conception of the unity of the lode as a single geological problem, and every showing of value was soon attacked by a swarm of claimants to a share of its visible or potential millions.

It is no wonder that the situation attracted the best brains of the legal fraternity on the Coast, among whom Judges Quint and Mesick were prominent attorneys for the 'many-ledge' plaintiffs, with William M. Stewart (familiarly known as 'Bill') and Curt Hillyer for the defendants, aided by such men as Garber, Thornton, Ellis, Huntington, Judge Baldwin, and others who later maintained their reputation in other arenas. Trained experts arrived sporadically, for there were few in the country at that date, and it seems a sad commentary on the importance of the presiding judges that I am unable to recall their names, while the scenes and personalities below the bench are as vivid as in the days when they were enacted. Judge Goodwin gave us a first-class newspaper in the 'Territorial Enterprise', on which Mark Twain was then a reporter and spent many hours in our office to get a glimpse of my partner's wife, whom he had hoped to make Mrs. Clemens; another well-known char-

acter was Adolph Sutro of tunnel fame, for whom I made a relief model of the country around Virginia City, covering a square six miles on a scale of four feet to the mile; but as in the case of the Latrobe tunnel, run to explore the west outcrop on the Andes location, the workings had reached below the level of his tunnel before it was completed, and complications arose that led him to choose the opposite side of the street when we met, as in the old-time story, for he had come to look on us as his natural enemies. Our bread was not buttered on the same side.

The only visitor of prominence from the outside was Baron Richthofen, who was on his way to China to examine its mineral resources for the Prussian government. His visit was very short, and the only memento of it was the word *propylite,* which he applied to the altered andesite of the East country at Virginia City.

Among the mining superintendents, I recall Sam Jones (afterward U. S. Senator) of Gold Hill, H. Yerrington of the Kentuck (later of the V. C. & T. R. R.), Isaac Requa of the Chollar-Potosi, Charles Bonner (later of North Bloomfield), and Louis Janin of the Gould & Curry; Pat McKay of the California, and James (Jim) Fair, and Buckminster of the Ophir. I can visualize several others, but cannot name or place them. How little the geologic problems interested these men can be judged from the fact that only Mr. McKay used to come to the office to discuss questions of cause and effect. To the others the discovery of a new clay seam, increasing the complications, was more important than the causes which made it, as the many-ledge theory held that even if it cut an orebody in two it made the orebody two lodes. But of this more anon!

We were a community of some 25,000 souls on the outskirts of civilization, connected with it by telegraph, but separated by 190 miles of mountain stage-road known as the Kingsbury grade, even if it was a first-class piece of construction for those times. It was kept in splendid condition, sprinkled daily to lay the dust, and all freight teams were compelled to park at nightfall in suitable places that the three Concord coaches leaving each afternoon could make the trip to the railhead at Placerville on a schedule of ten miles an hour. Some staging! Each stage was well ballasted with heavy bars of bullion, except on the memorable ride of Horace Greeley, who, traveling light, was tossed about like a grain of corn in a popper, while his plea for less action only elicited from the driver, "Keep your seat Horace, we'll get you there on time", if Mark Twain's veracity ramains unquestioned; which reminds me of Twain's lecture on the Sandwich islands after his return from Honolulu—not one word about the islands but the Greeley story with infinite variations, and the audience in a continuous roar of laughter.

We were an orderly self-contained community. The 27 in the cemetery, who had died with their boots on, slept peacefully. Tom Peasly, the last of the gunmen, who killed his opponent in a Carson City bar-room after being shot through the heart, begged the boys to get his boots off and they succeeded. We were no longer disappointed if we did not have a man for breakfast! Differences of opinion were occasionally settled in an unamiable way, as when Frank Farrington and his opponent tried to pot each other from the shelter of two telegraph posts on C street and I had to seek shelter from the unprofessional shooting. The attitude of the miners was strictly for law and order, and their number enforced obedience. No big body of men were ever better paid. Four dollars a day in gold for eight hours, when currency was worth about 40 cents, made them the best dressed body of workmen, when off duty, to be found anywhere. Saloons there were, and splendid ones, but their chief ornaments were valuable mineral collections, to which the men were proud to contribute (one of these belonging to Ed. Powers was exhibited in later years at the Horse-shoe saloon in Seattle); the chief subjects of conversation were rumors of new strikes and the fluctuations of the stock market, in which, to the last man, all were interested. I recall but one regrettable case of sabotage, and that was the burning of the Melodeon, as the vaudeville theatre was called, under the mistaken impression that it was the property of Mr. Bonner, who had been instructed by the directors of the Gould & Curry mine to reduce wages to three dollars. When a large body of men appeared at the office, Mr. Bonner slipped out of the back door and quit the city, as recorded in the following doggerel, which was a roaring success at the Melodeon for a short run:

> "Mr. Bonner, the son of a gun
> From Virginia City he had to run.
> If we'd 'a got him, before he got away
> He'd never 'a seen three dollars a day!"

It seems certain, however, that the fire was accidental or an act of private revenge, as the miners were active in fighting the conflagration.

This attitude was also of vast importance in maintaining order during the exciting times in the autumn of '64 and the presidential election. The city has a hotbed of secession. No small number of our citizens had drifted across the plains to escape the draft, some were deserters from both armies, and others were refugees from the war-devastated States on the fighting border. Their sentiments were well known to me, for I came into close contact with them while driving a four-horse team from Illinois to the Far West in '63. In September the Democrats carried the local election, but, thanks to an aggressive fight, the Republicans turned the tables by a good majority in November. If a man became too blatantly 'secesh' the Provost-Marshal was sure to land him in the pen, where the salt-train camels, in a near-by corral, made both night and day hideous with their perpetual groaning. I had to demonstrate to the foreign-born element that the Democratic party of those days was the representative of aristocracy in Europe, and I have never found cause to regret that, being without a vote, I paid $16 for four poll-taxes and voted my four men as a patriotic contribution. The night before election we had a parade with 2400 torches in line, for which

I painted many of the transparencies, and swept the town to the song of

"What's the cause of all the row?
What, what's the matter?
Doc. McMeans and all his crew
Cannot put secession through!
That's what's the matter!"

Next morning the whole city talked in whispers—we were like a lot of malamute dogs—decidedly 'husky', but we helped to win the fight, as the gold we were mining helped to save the Nation! When the result was known, the Silver Cityites, who laid down a Confederate flag in front of the polling-booth, sent a big covered wagon to Virginia City filled with mourners mopping their eyes with huge bandanas. The horses were draped in mourning; four reversed brooms bound with black crape ornamented its four corners and a huge triangle heralded its coming with a doleful dong! dong! The procession was a pronounced success, until it reached Gold Hill on its return journey, where it was ambushed by the Brown Rangers and met an ignominious fate! Thenceforward the staple excitements were stock-gambling and litigation.

The orgy of stock-gambling was beyond belief, but the tale has been told by better pens, so let it pass. Bret Harte's story of the Devil and the stock-broker was admirable. The Devil fishing for souls from the parapet of a church in San Francisco was only moderately successful, but finally caught a stock-broker. The broker, smarting under the rough treatment he had received, bet His Majesty that he could beat him at fishing, and Satan, knowing that he had the broker anyhow, took the bet and an afternoon stroll down the street, leaving his tackle with the broker. The broker was in his element, landing the poor fools so easily that when, after a terrific struggle he landed the Devil himself, the latter confessed his inferiority and asked what bait had brought such success. The broker whispered in his ear "wild-cat"!

It was not long after taking my seat at the drafting-table before it became apparent that a comprehensive map of all the workings on the Lode, on a continuous sheet, would be of great value in working out the difficult problems that faced us. Through the courtesy of Marlette & Hunt and Mason & Ostrom, both firms of surveyors, I was able to make such a map on a scale of 100 ft. to the inch, which showed fully 90% of the developments at that date, and this map was religiously posted up monthly as long as I was at Virginia City. This was again posted up for the survey of Clarence King, and again, at a later date for George F. Becker, so that the result of this work (which took five months) when published showed over 250 miles of underground workings, including drifts, shafts, and winzes. The squares on the key-map were based on the magnetic meridian, as the general trend of the Lode was magnetic north and south, and gave the foreman an easy method of determining the direction and distance to be run to reach any objective. The system of squares also gave us the means of outwitting the 'wire-tappers', who were learning the developments as quickly as the mine-offices at San Francisco. By lettering the squares 1, 2, 3, etc., and A, B, C., etc., we were able to code our messages and easily change the code by altering the arrangement.

Improvement of the maps for use before a jury was the next thing. Ross Browne humorously declared that a mine-map looked more like a bunch of varicolored spillikens than anything else, and he was not far wrong, for on many of the early maps there did not seem to be any unified scheme of workings, and they must have been absolutely unintelligible to the average juryman, who does not usually possess the ability to make a mental picture, giving to each part of the map its true position in space with regard to all others, as they appear in a model—a refinement then unknown to us. We did, however, simplify the exhibits by adding to them separate tracings of each level, the whole series being correctly superimposed and clamped together, so that each sheet could be discussed individually; then, by turning over the sheet we could descend to the next level, and so on, while in each case the succeeding level in depth could be faintly seen through the semi-transparent cloth. The main shaft held the same position with regard to the margins of all the sheets, and to make it easy to correlate the depth of the workings of the different companies involved, the depth below the outcrop of the Eldorado location (the highest on the lode) was added in brackets to each level shown on the map.

The instrumental work underground was no child's play, especially when great accuracy was demanded, as in spotting a raise to meet a shaft, or a winze from an upper level. Time was deemed so valuable that the hours necessary to project the surface base-line to each level as it was opened were begrudged as dead waste, while the variation of the needle was necessarily very erratic in the drifts. Our worst enemy, however, was the instability of the ground, especially in the vicinity of the big blue-clay seams, which, when exposed to the air began to swell with inconceivable force, disturbing all reference-points in the neighborhood. It was necessary to replace the timber ten or twelve times to keep a short drift open during the trial of the Burning Moscow v. Ophir case, and when finally abandoned it was completely closed in a few weeks. In some stopes the ore was so completely crushed as to be known as 'sugar-quartz'. In the Bullion mine slabs of quartz had been polished to a lapidary's finish. By the time the 700-ft. level was reached the old shafts were out of plumb, and had to be abandoned. On the last day that the old Savage shaft was in operation the cage stuck at 550 ft., and 150 ft. of hemp rope coiled up on the hood. When the engineer hoisted without being notified, the cage shot up when the strain pulled it loose and I spent half a minute on its floor in pitch darkness. Did I think of all my sins—not much! at the 500 I got my bearings, at the 200 I was on my feet and safe, unless the transit legs should break and make trouble. When I went home without a transit (smashed by icicles at the Yellow

Jacket 480), and a rotten rope had sent an avalanche upon us in the Eldorado incline, and I had spent four hours in the abandoned stopes of the Seneca in black darkness without a dry match, there was no more peace in the family circle. No mining geologist should get married! He is too much away from home and runs too many risks for marital comfort!

Even in those early days we began to feel the steady increase of temperature by causing unequal expansion in the transit, but not until several years after my time did the high temperatures call for three relays on a shift and seriously increase the cost of mining. Digressing for a moment, it may be said that at the date of Professor Becker's survey, the cooling-room was 100°F. and the workings anything from that to 140°. As he could not stand the heat for any lengthened period, I made him a mask, covering the mouth and nose, to which was attached a gauze-wire cup filled with ice through which he had to breathe. In the '90s, during my last days underground with Emmet Boyle, clothes were useless, our note-books were thin boards, and pencils a solid piece of black chalk, for the glue melted out of an ordinary pencil and a paper book became a lump of saturated rag in a few minutes.

It is useless to go into the details of how we passed from the plank-lined shaft to the modern crib, from the bucket to the guide-controlled skip, hoodless at first; from a rag tell-tale on the cable to a clock-faced indicator; from dependence on the brake to direct hoisting; and saved re-handling of the load in a shaft, which changed from the vertical to an incline, as at the Crown Point & Belcher, by instituting the 'giraffe', which carried the car up the incline on a level platform, so that it could be run directly onto the cage.

The reduction of the ore to bullion, however, cannot be passed by in silence. There were no concentrators or classifiers between the battery and the amalgamating units. The millmen fell back on modifications of the old Mexican 'patio' methods, grinding and amalgamating the crushed ore in large Wheeler pans, with the addition of salt and bluestone, and settling the pulp in agitators, from which the waste water and slime passed over the rim. The average extraction was about 65%, and if this amount or over was returned to the custom-mills, no questions were asked. Grab-sampling was the universal custom. Few mines owned their own mills. Under these conditions it is not surprising that the position of weigher at the mines was a most desirable means of making a living. Some of the mills made an effort to impound their tailings for future treatment when oxidized, but the vast bulk went to waste in Six-mile and Gold canyons, to the amount of something like $100,000,000! Recognizing this waste, which was rich in quicksilver, Billy Welch of the Gould & Curry mine, whose mill was on Six-mile canyon, and myself, prospected the canyon. We found many little pockets of mercury in the pot-holes, but too scattered to pay for collection, and traced some of it down to Carson lake, but found no bodies workable with such appliances as were then in existence, and badly mixed with vegetal matter.

Nearly all the mills were situated in the valley of the Carson river as far as Dayton, or else in the Washoe valley due west of Mt. Davidson, the wagon-haul ranging from 12 to 25 miles, at an average cost of $5 per ton; and long were the teams and huge were the loads that daily swept through the Devil's Gate at the south end of Silver City. Timbers were brought from the Sierra Nevadas on a heavy up-grade of 12 miles, and later on from the end of the V-flume at Carson City when these eastern slopes had been denuded. Fire-wood from the same source cost $14 per cord and later rose to $16. In one memorable year, when three feet of snow fell overnight in the latter part of April, the price went up to $40, and the Chinamen made fortunes out of the roots they had dug from the deforested mountain.

Under these conditions the cost of mining and milling was about $16 per ton, and by the end of 1866 ore that would average this figure was becoming a scarce article in the stopes. No new discoveries were being made, and a reduction in the cost of transportation and supplies by building a railroad seemed the only salvation of the district. Mr. James had already examined the northern route through Long valley to the Truckee river, down which the Central Pacific proposed to build, so with him at the transit and myself at the level, we worked south and located a feasible route by way of Carson City and the Washoe valley to the present site of Reno. A detailed statement of the then actual traffic between the termini, and a careful estimate of the cost of construction and equipment showed that a reduction of 50% in freight-charges would still leave a fair margin of profit. As a matter of fact, the cost of the road, with a slight change in the route, was close to the estimate of some $2,000,000, and paid for itself in two years. It was hoped that the principal mining companies would assist in financing the enterprise, but they stood aloof on the ground that such obligations might depress the stock market; but, after much dickering, a scheme was worked out which satisfied the parties who were furnishing the bulk of the capital, and the necessary signatures of the presidents of the contracting mining companies (save only one) had been secured, when the stock market went to smash and the project fell through. Shortly afterward, however, Sharon and Mills secured a new charter; James was notified while eating his Thanksgiving dinner in 1868 to take the field, and the line was opened in exactly one year to a day. During the bonanza days of the '70s the traffic rose to more than 40 trains daily each way, for a cubic foot of timber went into the C. & C. stopes for every cubic foot of ore extracted, so thoroughly had the orebody been crushed.

This collapse of the stock market killed a countless number of wild-cats, and potential millionaires became real beggars overnight. Moreover, the one-ledge theory had won its fight, and money was so scarce among the many-ledge claimants that the armed posse who had held the stopes of the Bajazet & Golden Era against all com-

ers, were glad to accept their per diem wages on a basis of 24 hours to the day! The end of litigation came suddenly. During its pendency neither side had been able to prove its theory. The one-ledge men had not been able to prove that the veins east of those on which they were working united in depth, although it seemed probable; neither had the many-ledge advocates proved that they could not, so that it is no wonder that the juries of non-scientists never agreed, and I do not recall a verdict for damages or possession. When the suit of the Bajazet came to trial there was still want of proof, but we presented a cross-section showing a probable connection at no great depth below the actual workings. The Court promptly ruled that it was not suitable evidence and ordered it withdrawn, and the ground that is contained speculative and unproved matter to influence the jury. As a matter of course the jury failed to agree. On retrial we offered the identical cross-section map without change of a single line or letter, as the then state of exploration. The case was complete; the unity of the numerous parallel outcrops was accepted as a fact; the legal fraternity drifted away to other more lucrative fields and the community settled down to the actual business of mining.

As might have been expected, there were many laughable incidents to mitigate the dreary proceedings in court, and many of the practical miners came to grief. One of these whose testimony had to be smashed, stood up well under cross-examination until the lawyer worked back again, from the domain of quartz in the mineral and vegetal worlds to the inevitable clay seams, when the following colloquy took place: "Captain, you testified there was a clay seam in the west cross-cut?" "Yes, Sir." "And it dipped 60°?" "Yes, Sir." "Was that from the horizontal or vertical?" "From the vertical." "Captain [as if the questioner were in doubt], how many degrees are there in a circle?" "Ninety." "Did you never see a circle with more than ninety degrees?" "There might be if it was a very large one" [with a sigh of relief]. "You may step down, Captain."

As before stated, we had few trained professional experts, for the schools had not then trained such persons to any noticeable extent, but the troubles of one, who has long since ceased to worry about mundane affairs, come back to me vividly. He had been a witness for the one-ledge theory, and on re-trial of the case was found among the talent for the other side. Curt Hillyer piteously made him eat his first testimony from beginning to end, page by page, and when the Professor said, "I would like to explain," he replied, "You shall have all the time you wish when I get through". At the close of the cross-examination, when asked why he changed his opinions, the answer was, "On later developments." "Please state where they are"—an impossibility, as none had been made. The final question, "Now is it not a fact, Professor, that you are receiving a larger fee in this case than in the former?" No answer. It was tragic. The Professor's hobby was conchology, and there must have been something about his personality that induced the boys to make fun of him. At any rate most 'ologists at that date and many years later were thought by many people to be a little 'off', you know, and fit subjects for practical jokes. As an entomologist I have had my share, and have retaliated by making the hobby a camouflage to the real object of my presence in several Californian camps when secrecy was advisable.

What possessed my partner I do not know, but with the help of two miners, sworn to secrecy, they cut a clean seam in a drift not often used, where a healthy clay seam would be of considerable value to the contention of the other side, and carefully filled it with the well-known blue clay of the Lode. Following this we held a subdued conversation near the attorneys to the effect that it was strange they did not know of this seam, the result being that when the Court adjourned at noon, they asked for a recess of two hours to investigate some new evidence just called to their attention. A delegation from both sides went underground and sure enough there was the evidence so greatly desired, until somebody picking into it, as men naturally will, unearthed an oyster-shell! When the Court met, the attorneys explained that they had been mistaken, and the judge, who had been posted, ordered the case to proceed, but failed to suppress a faint smile. Costs: a bottle of champagne.

All cases were tried before juries. It was easier to influence the judgment of one man out of twelve than the judge on the bench, as proved by the fact that the probable verdict was usually, if not always, known by some outsider before it was rendered, in spite of the precautions to prevent leakage. The jury when once empanneled were never allowed to go home or even see their wives without a deputy sheriff being present. They were guarded by a cordon of deputies, and these in turn by men employed by the litigants; and when a case lasted a fortnight it is not difficult to realize that their judgment might be biased against those who had got them into the hole. For instance, our next-door neighbor was drawn for duty the day he returned from his honeymoon, and for two weeks never had a moment alone with his wife, who was an entire stranger to the town, and disconsolately walked the sidewalks in front of the office, hour after hour!

For reasons unknown, I was appointed State Mineralogist in the winter of '65-'66 and owing to the general sentiment about 'ologists, the office very nearly became honorary, as the next legislature attempted to divert the funds from which the salary was to be paid. This incident illustrates the light esteem in which science was then held by the masses (or "them asses" as the 'Argonaut' called them). The office desired to secure a valuable collection of the State's mineral resources for the Grand Exposition at Paris, but though hundreds of circulars were sent out asking contributions, to be carried free by stage or express, the replies were so pitifully small that I sent my private collection of some 700 specimens along with them, and never got it back. In a similar way, the annual report, of which the legislature doubled the num-

ber of any other, found small favor among operators, as the closing chapters called attention to the necessity of curbing wild-cat schemes, the folly of building mills before the mines were developed (some of them never dropped a stamp), or of attempting the reduction of complex ores by the same methods used on the simple combinations of the Comstock. No one denied the facts, but an abundance of abusive letters reached the breakfast-table and spoiled my wife's appetite. Conditions have changed so little that it would be pertinent reading today.

In 1866, Aurora or Bodie was our nearest mining neighbor to the south, with Humboldt and Austin to the east, but all of them were from 100 to 200 miles away. Slowly a few other camps got a foothold, but Nevada is inhospitable to the prospector. Rivers and lakes are few, and much of it is desert. Up to 1866 the southern portion was an unknown Sahara, traversed only by the Butterfield stage-route, which passed through Las Vegas (the meadows). Dave Buell, an intrepid explorer, had been compelled to turn back for want of water; Stockbridge had gone into the desert and never returned; Judge Ralston had perished miserably chasing the desert mirage; and Breyfogle had turned up at Las Vegas, ragged, wounded, and deranged, but with splendid specimens of gold ore. Stories of rich strikes at Pahranagat in southern Utah reached Virginia City by roundabout ways, and a bee took lodging in the brain of Governor Blaisdell. Election was approaching and it would be a great feather in his cap if he could pioneer a route across the wilderness and bring the trade of the new districts to Nevada's western towns.

So the expedition was organized, if inviting oneself can be so called. Each man furnished his own outfit, which ranged from that of an old campaigner like myself, and chum, to a one-horse wagon that carried a big cooking-stove and two men. The Governor had a buggy with two horses and three pack-mules loaded with barley, and was accompanied by a corporal's guard from an Army post to take care of the Indians. The episode was serio-comic. Among the company we had perfect specimens of Faith, Hope, and Charity, Optimism, Pessimism, True Grit, Indomitable Preservance, Selfish Laziness, Foolhardiness, and Caution. But that is another story. Disintegration soon started, and by the time we reached Silver Peak the guard returned home; the Secretary of State had important business at Carson; the Governor would have gladly quit, but was ashamed to do so, and, if I remember rightly, only 12 to 15 went into the desert and were lost to their friends for three months, emerging minus one man and several horses, after nearly a thousand miles of wandering, including the many times we had to take the back track for want of water, or die. We made no discoveries, but we left a wagon-track from water-hole to water-hole, and I was able to fill out the map of southern Nevada, till then a blank; while during the autumn several new camps were located on our trail.

When looking back, all the incidents of these years seem trivial. There were no spectacular incidents. We were an orderly community, playing with a vast complicated toy; proud of our success when a few pieces fell into their true places; never disheartened by failure, and willing to pass on to others the task of relegating the remaining fragments to their true places. Others have followed who were more fortunate in their early education. I can recall only one name (Louis Janin) that became a household word in the long list of world-known mining engineers, but at the end it is pleasant to subscribe to the sentiments of a poet whose verses appeared in the 'Atlantic Monthly' for 1860:

> "And when foot-weary with the day
> My longing spirit only feels
> The tremor of the chariot wheels
> That bears some victor on his way.
> I'll deem it very kindly chance
> That gives the apprehension clear,
> To feel the pageant far or near
> That moves to other's utterance."

Dr. A. L. Meyer has devised a method for determining the amount of fine dust particles in the air, which is based on the principle that water when brought into intimate contact with air removes the insoluble particles that are in suspension, states the 'Journal of Industrial Hygiene'. Dr. Meyer employs a graduated syringe which enables him to measure the quantities of air and water used and in which thorough contact is effected by shaking the two phases. The number of particles taken up by water is estimated microscopically with the aid of oblique illumination and Levy's blood-counter. The average deviation of the number of particles per cubic centimetre of air containing 20,000 to 80,000 particles obtained by this method was not more than $\pm$ 4000 for 100 cc. and $\pm$ 2000 for 200 cc. samples. The method is specially suitable for the determination of smoke particles in the atmosphere and for testing the efficiency of air-filtering devices in various ventilation schemes. As a comparison is not made with figures obtained by other methods, it is impossible to assess the accuracy of the method, which has also the drawback of not estimating the water-soluble particles.

Although large deposits of iron ore and phosphates are known to exist in Cambodia, alluvial gold in Laos, and zinc, lead, antimony, and tin in Tonking and the Annamese hills, little exploitation has been done in French Indo-China, according to a British consular report. Coal is raised at Hongai, Dong-trio, and Phamme, all in Tongking. Zinc is worked at Cho-Dion and Trang-Du (Tongking); the output was 48,000 tons in 1916, but decreased subsequently. Tin and wolfram occur chiefly near Langson in west Tonking and at Hinbun on the Annam-Siam frontier; the production in 1918 was 604 tons. Graphite, antimony, lead, and iron are found near Haifong, where a smelting furnace has been in operation since 1919. The chief causes of the decline of mining in Indo-China are high wages, working costs, and freights, the state of the metal market, and competition from other countries.

The Motor-Truck in Mining

By F. W. Fenn

*All industry has been passing through a period of readjustment. The years of the War, with their extraordinary demands, are behind us. Yesterday the object was production at any cost; today every mining engineer and executive realizes that he must obtain the minimum cost. This is especially true of concerns that are still paying high wages for labor, but that no longer receive war prices for their products. World-wide economic conditions have brought about a readjustment of commodity values everywhere. A buyers' market is at hand; costs must be hewn to the line. Smaller margins of profit necessitate, among other things, quick and economical transportation.

During the past two or three years methods of haulage around mines have been undergoing a gradual change, incident to the changed demands of industry. A striking illustration of this evolution is the introduction of the motor-truck to overcome the handicaps of inefficient transportation by human or animal power. It is obvious that the economical conveyance of such material as ore requires mechanical power, as the distance from the mouth of the mine to the mill, where the ore is reduced, is often considerable.

In the mining of coal there has been a tendency of late to motorize transportation. There are about 4000 coal mines in this country at the present time; approximately 2000 of these are without railroad connections. They may be roughly divided into shaft- and adit-mines; in each case it is necessary to haul the ore to the railroad-spur for transportation—the most expensive operation connected with the production in these mines. For years it has been customary to use two-horse teams in this work. Obviously, this is an expensive method, as a man and team can deliver only from 5 to 8 loads per day over an average haul.

Recently one mine operator made some vitally interesting investigations to show the faults of this method as compared with motorized service. On a half-mile haul he stated that his two-ton truck carried an average of 77 tons in 4½ hours; this was made possible, in a measure, by reason of excellent facilities for handling the coal at the pit, where the coal was loaded by means of a bucket-conveyor. It would have been necessary to equip three to four teams with specially-designed dump-bodies to have done the same amount of work.

Inasmuch as many of the trucks in the mining industry are operated independently, no well-defined scheme of routing is possible. Frequently, on this account, a long wait occurs at terminals when a number of trucks arrive at the same time. This is especially likely to occur if the end of the chute is low, thereby interfering with the loading.

It is important, therefore, that the supervisor of

A 5-TON TRUCK HAULING GOLD ORE AT THE PORTLAND MINE, AT VICTOR, COLORADO

*An abstract of an address delivered before the American Mining Congress at Chicago, on October 20.

traffic develop and encourage as far as possible the adherence to a regular schedule of trips to the mines. He should emphasize the fact that the lack of storage-capacity may result in delaying production if trucks fail to appear on time. When trucks are operated by one company, hoppers of sufficient capacity enable the operator to maintain regular schedules and avoid lost time on the part of the trucks. For this reason the design and construction of the loading facilties at the mine should be carefully considered. To secure efficiency the distance traveled by motor-truck from the mine to the railroad-spur should not, in general, be so long that a round-trip cannot be made in an hour.

Generally the mines of the type to which I have just referred are provided with adequate tipples. This simplifies the problem of loading the trucks; the transfer of the load into the freight-car is frequently more troublesome. However, where the smaller mines are in the neighborhood of larger ones with fully equipped railroad-loading facilities the ordinary dump-body can be advantageously used in connection with the elevated platform. Generally speaking, no more than one minute should be consumed in loading and not more than 3 or 4 minutes in unloading. Where the same work has to be done by hand, 20 to 30 minutes is required for unloading. On the other hand, by means of a hydraulic hoist operated by the motor in the vehicle, the body is raised to an angle of 40° and the load is dumped by gravity through apertures at the rear; the bed is emptied usually in 30 seconds. To facilitate unloading, motor-wagons also are designed so that the contents may slide through side or corner exits. Power-trucks generally are equipped with iron or steel chutes, one end of which is attached to the vehicle, while the other is to discharge at the desired point. It is significant that the products from approximately 3300 mines are being conveyed by motor-trucks or wagons at the present time.

In the mining of copper, lead, and zinc, the methods employed are almost identical with those used in coal mines. The quantity of supplies and machinery required for efficient mining and milling of such ores is much greater than that necessary for extracting an equal tonnage of iron ore or coal. Many operators are obliged to transport both their products and supplies to and from their local warehouse by motor-trucks, inasmuch as the tonnage shipped from any mine frequently is not great enough to make it profitable for the railroad to build side-tracks.

Out on the Pacific Coast an engineer converted a motor-truck into a locomotive for transporting standard-gauge flat-cars used in the reconstruction of the 1400-ft. tunnel at San Rafael for the Northwestern Pacific Railway. It was imperative to avoid the nuisance from smoke and gas, which would attend the use of an oil- or coal-burning locomotive; on this account a searching investigation for an adequate substitute was made. The use of a motor-truck, the gauge of which was about the same as that of a standard railway track, was found to be the most feasible solution of the problem at hand. With comparative ease this locomotive-truck has hauled two 40,000-lb. capacity standard-gauge dump-cars and two 60,000-lb. capacity flat-cars into the tunnel on a 7% grade at one time. This is a more severe service than was originally planned.

In general the carrying capacity of the motor-truck in transportation of material from mines ranges from 3½ to 7½ tons. Frequently, a motor unit is used for hauling, not only its own load, but that of one or more trailers, with the result that the capacity of the machine is increased, without undue strain or distress, as much as three-fold. Another form of trailer system is that in which a tractor is the motive unit; it draws two trailers, each with a capacity of 7½ tons. The tractor is often equipped with a bed capable of bearing 5 to 7 tons, which increases the total capacity to more than 20 tons. The speed of such a combination ranges from 8 to 12 miles per hour on roads or trails, the gradient of which is as much as 15 to 20%. The 'displacement' value is roughly figured at 15 teams.

The superiority of the motor-truck over the team is revealed in an instance where the former travels 100 miles in a day—two round-trips of 50 miles each—delivering an average of 15 tons. The team, on the other hand, hauling only 3 to 3½ tons, requires 4 days under favorable conditions to make two round-trips. At the conclusion of this period of service the truck is as good as at the start, while the team is worn out, incapable immediately of further sustained work.

Unquestionably, operating costs can be reduced measurably in the mining industry through proper driving and routing. Long service is almost entirely dependent on the driver; he is the crux of the problem. It is well, therefore, to instill a feeling of responsibility in the truck-driver. An important question is the size of the fleet that is to be used. If it consists of ten or more trucks it will be found more feasible to hire one or two expert mechanics than to make each driver individually responsible for the maintenance of his truck.

In any event the desirability of schooling drivers is important. Practical demonstration has done more to bring about good results than perhaps any other factor. In addition to the routine mechanical instruction there are many fundamental laws of truck-operation that can be emphasized. A driver may not realize that he is needlessly damaging his truck by using one road in preference to another; even 30 or 40 miles over fairly smooth roads is more economical than 20 miles over trails.

If I were asked to summarize the basic advantages in the application of motor units to the conveyance of ores from the mines I would cite the following:

(1) Haulage of coal from the mouth of the mine to the consumer is made possible under certain conditions. This releases railroad-cars for the through shipments to points at greater distances.

(2) Ore for small mines can be transported to railroad-spurs.

(3) In the mines where deposit is close to the surface

the overburden can be removed as it is stripped by steam-shovel.

(4) Reliable delivery is established for supplies, mine-timbers, powder, etc.

(5) When the emergency arises mine-rescue machinery can be moved quickly.

(6) The elimination of 'camps' by transporting employees between the mine and towns.

In compiling cost-data it is well to remember that the most satisfactory results will be obtained if the costs are distributed evenly over the period represented by the life of the truck; this applies particularly to such items as the interest on investment, sinking-fund or depreciation cost, tires, and maintenance and repair. Interest is variable. The greatest value of keeping accurate costs comes through a careful analysis of these items; for this work the National Standard Truck-Cost System will be found helpful.

It is easy to neglect recording of service given by tires, thereby losing any dependable information on which to base comparisons for selecting further equipment. The advantage of recording every mile that each tire covers is obvious.

Manufacturers advocate a liberal use of oil and grease; in fact, they encourage the use of an excess. It has been demonstrated that plenty of oil and grease produces greater working efficiency and is more than repaid by the minimum amount of repair work incident to general

HAULAGE BY MOTOR-TRUCK AT THE WEST END CONSOLIDATED MINE, AT TONOPAH, NEVADA

paid during the sinking-fund period. If this period has been established at only a fraction of the life of the truck, costs during the remaining life will be without interest and sinking-fund charges, and, therefore, cannot fairly be compared with the former costs. For the sake of making monthly or yearly comparisons in motor-truck costs it is also desirable to distribute tire- and repair-costs over the entire period rather than lump them in the particular month they are incurred.

There need be no misunderstanding of truck-operating costs. All of the items of expense are known; motor-truck costs naturally fall into two classes, fixed and variable. The first classification includes the charges for retiring the investment, for interest on the investment, insurance, garage, licenses, and drivers. In the second category of charges we find such items as oil, gasoline, and tires, which are dependent on mileage. Items of repairs, parts, and lost time will perhaps be found the most overhauling. Lubrication is vital in the maintenance of the machine. Proper lubrication should be made the first consideration in garages that are operated by mining companies.

A RECENT discovery was made of asbestos-bearing rock in Canada, which gives promise of being of considerable commercial value, states a consular report. The deposit is in the serpentine rocks of the Canadian Pacific railway connecting Revelstoke and Arrowhead and is about four miles north of the latter point. The 'Montreal Daily Star' recently announced that a large manufacturing plant for making asbestos products is about to be constructed in the Province of Quebec. About 89% of the asbestos produced in Canada has heretofore been exported to the United States; nearly all of the Dominion's requirements of asbestos has been re-exported from this country.

Breaking the World's Record in Shaft-Sinking

By Walter Fitch, Jr.

Last September the Walter Fitch, Jr., Co. established a new record for rapid work by sinking 427½ ft. in 31 days. The record was made in the Water Lily shaft of the Chief Consolidated Mining Co. near Eureka, Utah. The shaft is vertical and was bottomed at 115 ft. at the beginning of operations. No water was developed during the record-making period.

The surface equipment consisted of two small hoists and two air-compressors. The shaft is 5 ft. 9 in. by 15 ft. 6 in. outside dimensions, divided into three compartments, each 4 ft. 4 in. by 4 ft. 6 in. Timbers 8 in. square were used; sets were spaced at 5-ft. intervals, and 2 by 12-in. lagging was used for the outside lining. We hoisted through two compartments, thus facilitating the removal of the rock and the lowering of timber.

We have in the past investigated and used many different sinking-buckets and devices for dumping at the surface, but we have never before obtained the results desired. Conditions seemed favorable in this work for record speed, so that one of our first steps was to devise efficient arrangements for dumping. Through the able assistance of H. L. Connelly, master mechanic for the Chief Consolidated Mining Co., a dumper was developed that gave entire satisfaction; about 15 seconds was required to discharge the contents. The accompanying photographs show the equipment.

Another important device which we have used in all the shafts sunk by us during the last five years, and which is indispensable for speed, is the suspended steel set, hung below the bottom set by two chain-blocks. Upon this the timbermen work without interfering with shoveling or drilling operations in the bottom. It consists of a framework of I-beams on which lagging can be placed, in any compartment, to serve as a working platform. It also protects the men in the bottom, and forms a shield to protect the shaft-timbers against the blasted rock. When timbers are being placed the steel set is lowered sufficiently to allow the placing of one set at a time. Before blasting, it is drawn up tight against the bottom of the timbers.

Hoisting was done without cross-heads, but with the use of non-rotating ropes. The compartments were

DRILLING IN THE WATER LILY SHAFT AT EUREKA, UTAH, WHERE A WORLD'S RECORD FOR RAPID SINKING WAS ESTABLISHED

partly lined to prevent the buckets from striking the timbers. It is surprising to observe how smoothly the buckets travel under these conditions and how the avoidance of cross-heads in shallow shafts adds to the speed and safety of operations.

Another detail that we considered carefully was the 'bonusing' of the workmen. We fully expected to make more than 350 ft. per month; therefore, to base the bonus upon the ordinary speed of sinking would, through excessive awards, have increased rather than decreased costs. A great proportion of the speed was obtained through the efforts of the men and the goodwill and enthusiasm displayed by them; but on the other hand the avoidance of lost motion and the efficient planning made the labor unusually effective. This is one of the reasons we were able to obtain the services of the best workers. It is possible that these same men could have worked as hard and perhaps have made only a fraction of the progress under less favorable conditions. Needless to say, the following bonus, commencing at 212 ft., did not appeal to the miners at first; but when they saw the sets going in at the rate of three per day they realized the possibilities and applied themselves with renewed spirit. The regular wage-scale was: shaftmen, $5.25; hoistmen, $5; topmen, $3.75.

The following schedule of bonuses applied only to men working a full month:

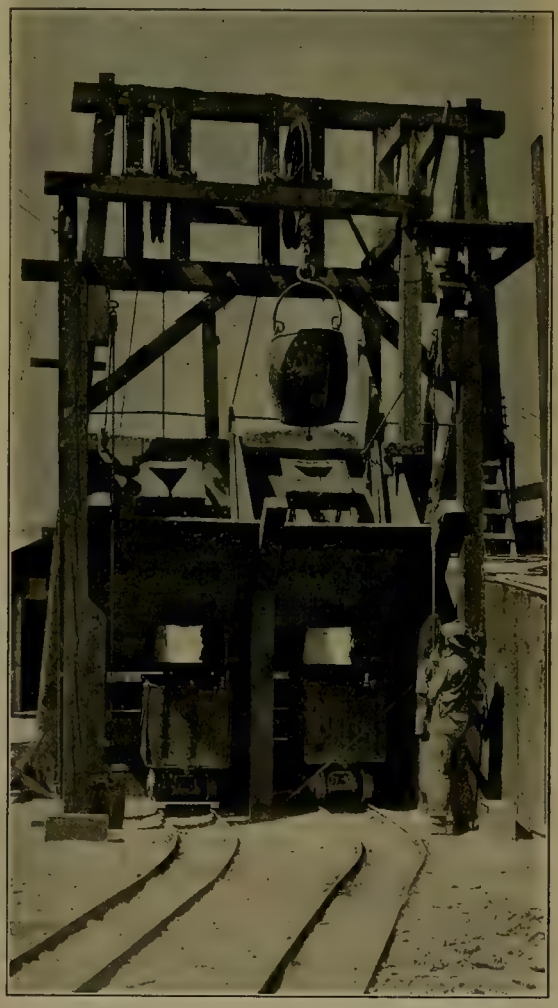
Progress made in 31-day period, ft.	Shaftmen, timbermen, and shift-bosses	Hoistmen and topmen
212	$15	...
262	30	$15
287	45	...
312	60	30
337	75	...
362	90	45
387	105	...
412	120	60
437	135	...
462	150	75

As the shaft was situated six miles from Eureka it was deemed advisable to take the men to and from work by motor-truck rather than camp them near the shaft. Small temporary camps are unpopular and, under such conditions, it is difficult to retain some desirable workers. The monthly turn-over of labor speaks for itself; there were but four changes made during this period. The crew made short work of any slackers. Men work more efficiently for a contractor for the reason that, as a rule, they can earn more money and make a better 'showing'.

The formation through which the shaft passed consisted of porphyry with the last 60 ft. passing through limestone. The unfavorable feature of the porphyry was its blocky and sometimes sticky condition. The blockiness caused over-breakage, and consequent difficulties in timbering, besides additional shoveling. The stickiness retarded the speed of drilling. In a second 31-day period we almost equalled this record with an advance of 416 ft. through hard limestone; here we overcame the additional hardness by the use of stronger powder. Hercules Gelatine LF powder, 35% strength, was sufficient in the porphyry, whereas some 50% gelatine was used in the limestone.

After blasting, the gases were replaced by fresh air, conveyed through an 8-in. galvanized pipe from a blower on the surface. This interval, of about 20 min, was set aside for lunch.

Seven Denver Rock-Drill company's Waugh Clipper-55 drills, one Ingersoll-Rand DCR-13 drill, and one Sullivan DP-33 air-tube rotator drill were used during the course of the month; an average of five machines was in operation each day. Hollow hexagonal drill-steel, ⅞-in. size, with a double-taper bit, was used.



HEAD-FRAME SHOWING THE ARRANGEMENT OF DUMPING DEVICES AND CHUTES

The fact that we were able to perform a complete cycle, that is, drilling, shoveling, hoisting, and timbering each shift instead of every 24 hours, as is the usual custom, added appreciably to the daily footage. We have found three short rounds each day to be more efficient than one or two longer ones. The accomplishment of the

record was helped materially by the co-operation and encouragement given by the officials of the Chief Consolidated Mining Co. J. D. Matheson, general foreman, and Henry Jarvis, shaft-foreman, deserve great credit;

DETAIL OF DEVICE FOR DUMPING BUCKETS

it was through their efforts and skilful supervision that the results were made possible.

The following table summarizes the details of the record-breaking operations:

Distance sunk, feet	427½
Period, days	31
Size of buckets, cubic feet	17
Powder used per foot, pounds	15.25
Average advance per day, feet	13.80
Buckets hoisted per shift	72.5
Sets of timber per day	2.8
Timbermen per day	4.8
Shaftmen per shift	5.7
Holes drilled per round	23.9
Rounds per day	3.0
Delay in 31-day period on account of repairs and power failures, hours	13.0

Gold Refining

*Gold produced from mines in general is associated with impurities, some of which are present in the ore; others are added during the processes of extraction and recovery. Base metals include copper, lead, bismuth, arsenic, and zinc; precious-metal 'impurities' include silver, platinum, and other members of the platinum group of metals. Refining has as its object the removal of these, for they often have an injurious effect on the physical properties of the gold, rendering it unsuitable for coinage and other purposes. Refining methods may be wet, electrolytic, or dry. These methods have been designated as inquartation, parting, or refining; but as all have the same object in view, it will be sufficient to call them methods of refining only. The composition of the gold that is produced from various parts of the world differs greatly, and several methods of refining have resulted. The wet processes are most suitable with bullion in which the ratio of gold to silver is small. Otherwise much silver has to be added, and extra expense involved. The electrolytic process is one that is suitable for treating gold alloys in which the precious metal is in large excess; it was developed in the North German refinery, at Hamburg. The anodes are made of sheets of the impure gold alloy or bullion, and the cathodes of pure sheet-gold. The electrolyte is a solution of gold chloride, mixed with an excess of hydrochloric acid, or a solution of any salt such as sodium chloride, which forms double salts with gold chloride. The electrolyte is maintained at strength by the occasional addition of gold chloride. During electrolysis the gold and most of the other metals go into solution, but on account of the low current-densities used, only gold is deposited on the gold cathodes, and of a fineness that is seldom under 999.8 parts per 1000.

In the dry processes of refining, the gold bullion is treated when in the molten state, the idea being to add some substance that reacts only with the impurities present and that leaves the gold unchanged, except for slight mechanical losses. It depends on the property of chlorine gas to convert the silver as well as the base metals into chlorides, without attacking the gold. The base-metal chlorides escape as gas, whereas the silver chloride collects on the surface of the gold as a liquid. The refining is conducted in clay crucibles, which are enclosed within graphite crucibles, to avoid loss of metal in case of accident. The clay crucibles are glazed internally with borax, to prevent the chloride of silver from penetrating. Chlorine is delivered into the molten gold by means of a clay pipe, which passes through a loosely fitting clay cover. The chlorine is generated from manganese dioxide and hydrochloric acid in a stoneware vessel.

The gold is charged into crucibles that have been heated previously; when it is molten a few ounces of borax is added. The clay pipe, the end of which has been heated, is then lowered into the metal and chlorine is admitted. The base-metal chlorides are immediately given off as vapor, which ceases as soon as these metals have been volatilized. The crucible is removed from the furnace and the gold is allowed to solidify; the silver chloride remains molten for some time, and is poured off; the gold is then cleaned and re-melted. Its fineness varies from 991 to 997; by repeating the operation, more silver is recovered. Of the gold originally present in the bullion, 98% is recovered, 2% going to the silver. This is recovered from the chloride by subsequent treatment.

*Abstracted from the 'S. A. Mining and Engineering Journal'.

Storage-Battery Locomotives in Metal Mines

By E. V. Daveler and R. E. Renz

*Introduction. The use of storage-battery locomotives for haulage in the metal mines of the West has been increasing steadily since 1913. The demand for more efficient haulage has resulted in operators giving serious consideration to this phase of the mining operations. The different methods of haulage may be classed as follows: hand-tramming, mule-tramming, trolley-locomotive haulage, and haulage by storage-battery locomotives. Hand-tramming and mule-tramming, of course, always will have their own field when the tonnage from any one level is not sufficient to warrant the use of haulage by motor. Trolley-locomotive haulage is well suited to long hauls underground where there is a large tonnage and ample head-room, and in ground that is readily held in place. The storage-battery has its particular field in drifts or haulage-ways that have minimum head-room; it has a wide range in the amount that can be hauled; and it can be moved easily from one level to another when operations demand. It can be adapted to the particular fields of any of the three other common methods of underground haulage. In considering the applications of haulage with storage-battery locomotives, the authors of this paper will consider especially mines in which they have had experience.

In the Butte & Superior mine at Butte, Montana, underground haulage with storage-battery locomotives has been very successful. The mine has been opened down to the 2300-ft. level, with mining operations carried on from the 800- to the 2300-ft. levels in the last nine years. The orebodies are wide and the ground is heavy, causing a continual shifting of the grade on the haulage-levels and making it difficult economically to maintain a constant height of the drifts and cross-cuts, which, accordingly, become narrow and low.

In the early part of 1913 it became evident that in order to deliver the required tonnage to the one shaft then operating, some form of power-haulage was necessary. Hand-tramming, due to the varying grade of the levels, had become inefficient; in fact, in some places it was impossible for trammers to push one loaded car. A study of conditions showed that, from a standpoint of safety, trolley-motors were out of the question, on account of the low drifts, and that the cost of upkeep of the trolley-system would be prohibitive. The low drifts made a trolley-system dangerous; also the moving ground increased the fire-risk. The alternative method of tramming was by storage-battery locomotives, which at that time, early in 1913, were in the experimental stage. However, it was decided to try the system, and two Jeffrey storage-battery locomotives were purchased early in 1913, and two additional locomotives in 1914.

Following is a description of these locomotives:

Weight of chassis, tons	$2\frac{1}{2}$
Weight of chassis with battery, tons	$3\frac{1}{2}$
Gauge of rail, in.	18
Wheel-base, in.	36
Length of locomotive, ft.	11
Maximum width, in.	32
Draw-bar pull, lb.	1500

These locomotives were equipped with two sets of batteries, one to be used while the other was being charged, thereby affording continuous service for the locomotive. Each battery consisted of 63 No. A-4 Edison cells having a capacity of 150 ampere-hours and an average voltage of 75. These locomotives were equipped with two motors, each geared to a separate set of drive-wheels by means of worm-gears in one reduction. With this construction it was possible to keep the maximum width down to 32 in. The speed of the locomotive is 4 miles per hour. The control is standard series-parallel with resistance-points between.

Provisions for Safety. For a year the operations were entirely satisfactory; then it was discovered that in wet levels the storage-battery cells would 'ground' and that, due to electrolysis, the steel containers were being corroded, causing leakage. This was due to insufficient insulation between the cells and the battery-box, a difficulty that was remedied by mounting the individual cells on porcelain blocks. This method of insulation is still in use, although the Edison company has devised a method of insulation by rubber bushings, which apparently is as satisfactory.

Early in 1917 the work required of the locomotives became particularly heavy and it was necessary to change the A-4 batteries before the 8-hour shift was finished. These cells were then replaced with A-6 cells, the battery having an ampere-hour capacity of 225. The number of cells to a battery was increased from 63 to 66, and later to 72, which is the greatest capacity we can accommodate on our present motors. This has improved the efficiency of the locomotive considerably, as the voltage is more successfully maintained at the end of discharge, and greater loads can be moved at higher speeds. At the present time the company has nine locomotives, each equipped with two sets of batteries. This discussion has given a general idea of the equipment and necessary changes from time to time.

One important advantage of storage-battery locomotives is the comparative freedom from electrical troubles, such as grounds and shorts in armatures and field-coils. The voltage is only 75 to 80, so there is little danger from accidental contacts. During the entire operations at the Butte & Superior mine there has been no accident of

*A paper read before the 10th annual congress of the National Safety Congress.

an electrical nature on the locomotives. As originally built, leads were connected to the locomotives by means of terminal screws and there was always the possibility of the motorman burning himself when changing batteries; there was also the liability of failure to tighten terminals, with consequent loss of power and eventual burning. This has been obviated by substituting a plug-type contact, thereby avoiding all danger from burning and poor contact. Another bad feature was the danger that the cover of the battery-box might be jarred out of position and might catch on timber posts; in that event the life of the motorman would be endangered. This happened in one case, but as the locomotive was traveling slowly the motorman shut-off the power and escaped serious injury. This has been remedied by bolting angle-pieces to the battery-box, so that the cover can be put on in only one way and can then be held securely in place. As originally furnished, switches, fuses, and instruments were mounted on a panel in front of the motorman. This has been changed and all exposed parts have been enclosed in metal boxes of substantial construction. Because of the small width of the locomotives and drifts, part of the motorman's body might extend over the side of the locomotive; there was danger that he might be caught on timbers and badly hurt. To prevent this, all locomotives are now equipped with a sheet-iron guard, so that the motorman cannot sit with part of his body extending over the side of the locomotive. Locomotives are equipped with modern head-lights and 94-watt focusing-type lamps. All locomotives are equipped with foot-bells, and as the speed is slow few accidents occur.

Care of the Locomotive. The locomotives furnished were not equipped with charging-meters, but we have added Sangamo ampere-hour meters with compensating shunts; there register the ampere-hour discharge and measure the proper charge, automatically cutting-off the charging-current at the right time. This helps in maintaining the batteries in proper condition and reduces the consumption of distilled water. The most regular and careful inspection and attendance must be given to the batteries; they should be regularly filled with distilled water; they must be kept free from moisture and dirt; and the tops must be well covered with vaseline to keep salts from 'creeping' and short-circuiting the terminals. Batteries should be cleaned regularly, and at periods of from 12 to 18 months the old solution should be poured out and all sediment removed by washing with clean old solution; water should not be used for washing, as it removes deposits from the plates, which is detrimental.

The batteries, after cleaning, should be filled with new solution and discharged to zero. The current is then reversed and the batteries are fully charged; this will bring the cells back to nearly full capacity. In handling the solution great care should be taken, as a 22% solution of hydrate of potassium is used; it is decidedly corrosive, attacking the skin and eyes severely. Rubber gloves and aprons, and goggles should be worn when working with the solution. The average life of the batteries is three years.

At the Butte & Superior plant one electrician cares for all the locomotives, making daily inspections. Charging is done on each level where locomotives are working; locomotive-barns are equipped with charging-panels, water-filling equipment, and chain-blocks with crawls for changing batteries. The distilled water is made on the surface at a cost of less than ½c. per gallon, and approximately 20 gallons is used per day for 18 sets of batteries. The charging-pressure varies from 125 to 135 volts and is supplied from small motor-generator sets.

Service of Locomotives. At the Butte & Superior mine the average length of haul is approximately 500 ft., varying from 200 to 3000 ft. About ten cars are hauled per trip, the weight of ore and car being 2250 lb. The cars are equipped with roller-bearings.

Operating-Costs. The cost of operation has been high for several reasons: first, irregular grades for the tracks; second, short hauls with a small number of cars; third, conditions in parts of the mine that are not conducive to long life of the battery.

The following statistics cover the year 1919:

Number of locomotives operating	9
Cars of ore hauled	605,372
Cars of waste hauled	132,415
Average haul of car of ore, ft.	800
Average haul of car of waste, ft.	747
Cost of power per car hauled	$0.00410
Cost of repairs for locomotive per car hauled	0.03205
Cost of motorman and helper per car hauled	0.06900
Total	$0.10515

Underground haulage with storage-batteries in metal mines is well exemplified by the Butte & Superior practice. In Butte both the Elm Orlu Mining Co. and the Anaconda Copper Mining Co. are using storage-battery locomotives with success. From the standpoint of safety the storage-battery locomotive is probably the most satisfactory machine for underground haulage.

Fluorspar (fluorite) is composed of calcium fluoride; it is usually purple, green, yellow, or white, rarely colorless, states an Imperial Mineral Resources bulletin. The chief use of fluorspar is as a flux, especially in the manufacture of steel. It has been used in increasing quantities in recent years in the basic open-hearth process, in which it acts as an efficient flux. Another important metallurgical use is in the preparation of electrolytes employed in the reduction of aluminum ores and in the refining of lead and of antimony. Fluorspar is used also for enameling purposes, for making agate-ware and opalescent glass, and for cementing purposes in the manufacture of emery-wheels and carbon electrodes. Transparent and colorless fluorspar is used in the manufacture of special lenses and prisms. Fluorspar is prepared for the market by hand-sorting, crushing, screening, washing, jigging, and fine grinding. The separation from zinc-blende, with which it is frequently associated, is effected by flotation. It is marketed in three grades. The silica limit for lump and gravel is 6%; for fluorspar to be used in the ceramic industry, 3 to 5%; to be used in the manufacture of hydrofluoric acid, 1%.

ZINC PLANTS IN OKLAHOMA TO RESUME OPERATIONS

The Bartlesville Zinc Co., at Bartlesville, Oklahoma, has announced the immediate re-opening of its zinc smelters that have been closed since spring. According to reports, 700 men will be employed. The company owns three plants containing in all about 1800 retorts.

PRODUCTION AT COBALT

During the month of October the silver mines at Cobalt and in the districts of Gowganda and South Lorrain in Northern Ontario produced close to 900,000 oz. of silver. The Nipissing was the largest producer, with an output of 340,000 oz. The physical condition of the Nipissing has improved during the past two months through the development of important ore-shoots in a new section of the mine. One narrow ore-shoot opened during October contains ore assaying 2500 oz. per ton. During the month, according to official advice, the Keeley Silver Mines in South Lorrain produced 102,000 oz. of silver, 36,000 oz. being in concentrate from the 20-stamp mill, and 66,000 oz. in high-grade ore. Developments are exceptionally favorable, and ore-reserves are estimated to contain 850,000 oz. Work is under way for the purpose of tracing the ore-shoots to greater length, and the mine is declared to be well established as a steady producer. The Coniagas Mines closed its fiscal year with a production of close to 1,200,000 oz. of silver, or approximately 20% above the record for the preceding year. The company paid $200,000 in dividends, as compared with $500,000 in the year preceding. The re-treatment of tailing has been suspended for the winter months, and work is now confined to the handling of ore from the underground workings.

NEW WAR MINERALS RELIEF BILL IS PASSED

The bill providing for more liberal interpretation of the War Minerals Relief Act has been passed by both houses of Congress. The final vote in the House of Representatives was taken on November 16. The bill was subjected to considerable opposition, led by Stafford, of Wisconsin, who argued that it would open the way to unmerited claims, but the bill was ably defended by Chairman Rhodes of the House Mines and Mining Committee, Chairman Sinnott of the Public Lands Committee, and others. The opposition was successful in making a point of order against the bill on the ground that the Mines and Mining Committee had no jurisdiction, as it involved appropriations which must be handled by the Appropriations Committee, but proponents of the measure were able to secure the adoption of amendments to accomplish the aim of the bill, which is to enable the War Minerals Relief Commission to pass on claims barred by administrative rulings.

DIRECTOR-GENERAL OF RAILROADS ASKS FOR A RECONSIDERATION OF THE GOLD HUNTER RATE-CASE DECISION

The Director-General of Railroads has requested the Interstate Commerce Commission to reconsider its decision in the case of the Gold Hunter Mining & Smelting Co., in which the commission found that charges on ores and concentrates from Sunset and Mullan, Idaho, to Salida, Colorado, were unreasonable. The Director-General asks that the commission hold that both the gross-value rule and the charges resulting therefrom, and the Salida rate are not unreasonable; also that the undercharges resulting from the deliberate and intentional mis-billing by the complainants be not waived, but be collected; and that the commission should make clear that no shipper, with or without collusion of a railroad, may with the sanction of the commission violate tariffs on the plea that in the opinion of the shippers such tariffs are unreasonable. The Director-General says the commission's recent report "cannot fail to be considered little short of an inducement of such violation".

COPPER SHARES IMPROVE

Copper shares have responded to the better feeling in the market for the metal. They were at their bottom prices last December—20 representative issues dropping to 21.83. They rallied to 28.78 in May, only to fall back again in August to 22.39. During October and so far in November they have fluctuated within a narrow range. Anaconda, Calumet & Arizona, Calumet & Helca, Utah, Ahmeek, and Cerro de Pasco are all up over 10 points from the low of the year, while the balance of the list has registered substantial gains.

Virtually all the major properties are closed down and they will probably not resume until well into 1922. It is only a question of time when the surplus will be reduced to such a figure that mines will again be re-opened. The worst period has passed, and the market is discounting better days for the industry. Below is a list of important copper shares showing the current high prices compared with 1921:

	Nov. 21, 1921	1921 low	Advance
Ahmeek	55½	40	15½
Allouez	24	16	8
Anaconda	45⅜	31¾	13⅝
Calumet & Arizona	53½	41½	12
Calumet & Hecla	260	210	40
Cerro de Pasco	34½	23	11½
Chino	27⅛	19½	7⅝
Copper Range	35¾	27	8¾
Greene-Cananea	25½	19	6½
Inspiration	38¼	29⅝	8⅝
Isle Royale	22	16¼	5¾
Kennecott	24⅝	16	8⅝
Miami	25½	15¾	9¾
Mohawk	53	43½	9½
Old Dominion	25	15⅜	9⅝
Quincy	42¼	33½	8¾
Utah	59	41⅛	17⅞

MINERALS SEPARATION CLAIMS $12,000,000 FROM BUTTE & SUPERIOR

Damages of almost $12,000,000 have been named by the Minerals Separation North American Corporation as due it from the Butte & Superior Mining Co. This estimate by the Minerals Separation management is placed before the master who has been taking testimony in New York in the

long drawn out litigation between the two concerns. A year ago, during court proceedings at Butte, oral estimates were made to the effect that Minerals Separation then figured its damages at $20,000,000. Since that time, however, the plaintiff has had some official data compiled by the Butte & Superior accountants showing earnings and their source in detail which have enabled a revision of earlier claims. It is understood that the amount mentioned, $11,900,000, was arrived at as a 'measure of damage' as representing the difference between the recovery possible by water concentration and by flotation.

DAVIS-DALY COMPANY SUSPENDS OPERATIONS AT COLORADO MINE AT BUTTE

Official announcement is made by the Davis-Daly Copper Co. that all operations are to be suspended at the Colorado mine on November 20. The Hibernia mine, a silver-lead-zinc property, will continue to operate. The shutting down of the Colorado mine will result in a complete suspension of copper production, and will also substantially affect silver output. The Colorado mine accounted for the entire copper production of 13,564,064 lb. last year. Of the 902,978 oz. of silver produced in 1920 the Colorado mine accounted for 539,000 oz., and the Hibernia 362,000 oz., of which 358,425 oz. was from lease ore.

The failure of the negotiations between East Butte and Davis-Daly, that had as their object the merger of the two companies through an exchange of East Butte stock for Davis-Daly shares, does not indicate, as recent reports stated, that Davis-Daly has any immediate intention of erecting a smelter to handle its own ores. Such a step under present business conditions has not even been thought of by the Davis-Daly management. Under present high construction costs a smelter large enough to handle the maximum tonnage that the Davis-Daly mine could deliver would cost several million dollars. With conditions in the copper-metal market as they now are, the Davis-Daly officials consider it the better part of wisdom to continue to have the smelting done by East Butte, which arrangement has been in effect for several years.

Davis-Daly has recently been turning out copper at the rate of around 600,000 to 700,000 lb. per month, while silver output has been averaging about 140,000 oz. per month. During the March quarter, copper amounted to 2,043,025 lb. and silver to 989,526 oz. Last spring Davis-Daly discontinued practically all work at the property not immediately essential, and working forces were cut to the minimum practicable for single-shift operation, six days per week.

A. S. & R. AFFAIRS

The American Smelting & Refining Co. has no present intention of emulating its leading competitor, the Anaconda Copper company, in finding an outlet for its copper production through ownership of brass- or wire-mills, although the subject has been given much thought. At the moment, lead constitutes the Smelting company's 'best seller'. It, of course, has no difficulty in disposing of all the silver that it produces. But copper and zinc have not responded to the point where increased operations may be ordered, although the company has been getting its full quota of recent copper sales.

The El Paso and Hayden copper smelters are idle. The Perth Amboy smelter and refinery have not been operated for more than a year, but could be readily blown-in if the Baltimore refinery had more than it could handle. The Tacoma plant, handling chiefly high-grade ore, has been able to maintain operations at about 75% of capacity. Kennecott and other Alaskan properties ship to that point, while the South American output from the Guggenheim properties has also been going to the Tacoma refinery. The Henrietta smelter, with two blocks of retorts in operation, constitutes the only zinc unit running, with the single exception of a plant for the production of zinc dust used in cyanide operations. The company has been forced to cease its tin production, as present low prices have made it impossible for Bolivian tin mines to continue profitably.

MINERALS SEPARATION ANSWERS COMPLAINT BROUGHT BEFORE THE FEDERAL TRADE COMMISSION

The Minerals Separation North American Corporation, respondent named by the Federal Trade Commission in its amended complaint against owners of patents on the flotation process, have filed answer in which a more or less sweeping denial of many of the charges is contained. The answer does admit "that by reason of its acquisition by ownership or beneficial interest of * * * patents in respect to processes, respondent now claims and asserts * * * a monopoly and the exclusive control of the processes for separation and concentration of ores covered by the patents * * *" The company claims ownership of some 50 patents covering flotation under which it has granted 140 licenses with aggregate tonnages of ore milled and in part treated under these licenses aggregating 28,000,000 tons per year. Allegations of stifling or restraining trade through its licensing policy, Minerals Separation denies.

Replying to charges of favoritism being shown in granting certain licenses, the Minerals Separation answers that on four occasions special terms were given to "meet special and unusual conditions".

These were:

(1) About February 1915, to the Anaconda-Inspiration group of mines when they agreed to use and pay large sums regardless of the outcome of then existing litigation over patents;

(2) In August 1915, when the St. Joe and Doe Run lead companies entered into agreement guaranteeing extensive use and payment of large sums to Minerals Separation at a time when basic patents had been declared invalid by United States Circuit Court of Appeals;

(3) About January 1916 the Desloge Lead Co., controlled by same interests as St. Joe and Doe Run companies, also agreed similarly as the other two, although basic patents were then as well declared invalid;

(4) About June 1916 special terms were given to Colusa-Parrott Mining & Smelting Co. "because the quality of its dumps, the low recovery, and the narrow margin of profit to said company made it equitable at the time, in the opinion of Minerals Separation, Ltd., to do so".

General denial was made by Minerals Separation to charges that it transported materials or apparatus, that it leased or sold equipment or engaged in interstate commerce. Also, that it had competition or that others lawfully engaged in similar business. As to its opinion regarding dominating the field of flotation, the Minerals Separation answer leaves no doubt in the statement: "If there are flotation processes not covered by (our) patents * * * respondent denies that they are important".

ARIZONA

Jerome.—The United Verde company is working steadily on its plans for providing modern and economical methods for handling its ores when the time shall arrive for resuming production. A contract has been let for 35,000 yd. of excavation and 18,000 yd. of fill on the site of the new ore-crushing plant, on the side of a low hill just west of the Clarkdale smelter. This work of preparing the ground is expected to require 100 days. At Clarkdale the company has completed the necessary buildings for its new Cottrell smoke-treating plant and has started erection of a separate stack.——James S. Douglas, president of the United Verde

Extension, is working toward lower freight-rates to the Pacific Coast, with expectation of shipping most of the company's bullion to the East by the water route if a tariff of $5 per ton can be secured from Jerome to Los Angeles. He compares this rate with the $9 per ton that used to be paid to New York by the smelters at Douglas.

CALIFORNIA

Grass Valley.—Production from the Idaho-Maryland group of mines is increasing. The old Eureka vein that produced bonanza ore years ago has been entered in virgin territory. It seems probable that the company will undertake the sinking of a new central working-shaft within a few months.——At the Central mill of the North Star Mines Co. 60 stamps are dropping regularly on ore coming from below the 5600-ft. level; 450 men are employed. The electric power-line to the Boundary mine west of Grass Valley is nearly finished. Modern hoisting and pumping equipment is

Colorado Shaft of the Davis-Daly Copper Co., at Butte

to be installed to make possible the economical mining of ore already blocked-out.

French Gulch.—New milling equipment is being installed at the plant on the Van Ness property. A better recovery is expected as a result.

Randsburg.—The California Rand Silver, Inc., is rapidly completing its 100-ton flotation plant. Murray N. Colman is superintending the construction and will operate the plant. Shipments of high-grade ore to the smelter continue at the rate of 10 cars per week.——The North Rand Mining & Milling Co. has received its compressor, receiver, air-drills, and other equipment. The temporary gasoline hoist will be replaced by an electric hoist, preliminary to deeper exploration.

Sonora.—E. H. Althoff and W. G. Busick have taken a lease and option on the Magente group. A number of promising veins have been disclosed and further prospecting is planned preliminary to starting a new shaft.

Weaverville.—The Bonanza King 20-stamp mill will be started as soon as sufficient water is available to operate the electric-power plant. A good reserve of ore has been blocked-out, according to reports.

COLORADO

Boulder.—The Caribou Hill Mining Co. is hoisting rich silver ore from a shoot pronounced by mining men to be one of the richest opened in this section. Samples assay as high as 1400 oz. per ton. This company started operations two years ago on leased property; it now owns or controls 14 claims, on which five distinct veins have been exposed. The same company is also operating the Wigwam adjoining the Grant County mines.

Glenwood Springs.—Applications for patent to a large number of oil-shale placer claims in Garfield county have been made recently. The Ventura Consolidated company and representatives of the Pure Oil Co., who have contracted for a large acreage of oil-shale placer claims, have been using a diamond-drill proving up the land. Three diamond-drill holes have been put down to a depth of 800 ft. and a rich oil-shale has been developed.

Idaho Springs.—The P. T. mine, on Chicago creek, located and operated in the earlier days by Tete Theobald, now deceased, has been taken over by Burkhart & Co. A compressor to be operated by electricity and a hoist are being installed.——Milling machinery formerly in use at the Scotia mill at Silver Plume has been installed in the mill at the Mendota mine of the Wasatch M. & M. Co.; the plant will shortly start treatment of ore, thereby saving hauling expense.

Leadville.—The mill of the Yak Mining, Milling & Tunnel Co. is being remodeled under the direction of E. L. Hartwell, superintendent, who is associated with the A. S. & R. Co. The low-grade ores will be treated by concentration, flotation, and jigging, and experimental tests are said to have shown that losses will average less than 20% instead of 40 to 50%. The mill for the present will be experimental with a view to determining the best milling practice. A successful result should be of far-reaching value to mines of the Leadville district containing low-grade ores.

Telluride.—Lessees on the Shamus O'Brien are mining and shipping ore to the smelter returning from $80 to $100 per ton.——Lessees on the New Dominion are mining ore from a 'paystreak' 14 in. wide, sampling $15 to $20 per ton.——High-grade ore sampling 114 oz. silver and 3 oz. gold is under development in the American mine. More men are to be employed.——Milling ore averaging $15 per ton gold, is being mined from a two-foot streak on the old Suffolk property, where lessees have repaired and improved the mill equipment and are now profitably milling their output.

IDAHO

Coeur d'Alene.—In the first nine months of this year the Caledonia Mining Co. made a profit of $53,845, chiefly from the leavings in worked-over stopes and drifts, according to Stanly A. Easton, president. The company now has on hand a surplus of $401,358 which is to be distributed to stockholders as soon as it is known what part of it must be deducted for Federal income and excess-profits taxes. Although no new ore has been found for a long time and there is little hope of finding more, it will take nearly a year to work the good ore still remaining in stopes and dumps. In the nine months the company mined 6963 tons of dry ore, from which 994,095 lb. of lead, 148,051 oz. of silver, and 4757 lb. of copper were extracted. The gross value was $84,423, the cost of mining was $7.48 per ton, or $52,105.

Seven carloads of ore has been shipped by lessees of the Sister mine on Canyon creek, a short distance above Wallace. The last car contained 31 tons and is believed to have been the richest ore shipped. The lessees expect to be able to continue shipments of a carload every two or three weeks. The ore is from a point 930 ft. from the portal of the main adit.

A nine-foot body of lead-silver ore was discovered recently in the east drift of the Lookout mine of the Coeur d'Alene. The ore opened is similar to that found in the upper workings of the Caledonia and Sierra Nevada mines; it carries lead both as carbonate and as galena. The ore-shoot is 300 ft. below the upper adit.

Rocky Bar.—The Idaho Gold Corporation was recently formed at Salt Lake City, Utah, to undertake the exploitation of the Vishnu, Mountain Goat, and adjoining gold mining properties. The two named have a record of production in the 'seventies, when $80 ore was mined. The additional territory comprises 2½ miles of promising placer ground and important water-rights. Development will be undertaken.

MICHIGAN

Houghton.—Calumet & Hecla, Ahmeek, Copper Range, and Mohawk have successfully developed either power-shovels or stope- or level-scrapers. Calumet & Hecla employed stope-shovels to good advantage in its conglomerate department just before the shut-down last April, and eventually the use of similar devices will be extended to all of its mines and subsidiaries. At Ahmeek the introduction of power-scrapers indicates that the stopes can be carried higher than has heretofore seemed practicable, and, in consequence, drifting on some of the levels was discontinued early in 1920 to permit a more extensive cutting of the stopes. Hereafter new levels can be started farther apart than has been the practice in the past. This in itself will result in a saving in mining costs. Copper Range has developed a combination power-shovel and 'picker', which not only aids handling but makes sorting possible. The shovel throws the rock onto an endless belt, along which stand two or three men who pick out the waste. This type of shovel and conveyor has been successful in the Champion mine, and others will be adapted for use in Baltic and Trimountain. All of these devices are made in the local shops, for the reason that no standard shovel or scraper is adaptable.

Extensive repairs are under way in No. 2 Gratiot shaft of the Seneca property, preparatory to the resumption of sinking. The old shaft-collar is being removed and a new collar will be constructed. Steel sets will be used and the collar will be concreted through the overburden, a depth of 95 ft. from the surface. The present depth of the shaft is 1420 ft. It will be sunk 1800 ft. deeper, at which point it will be connected with the 3rd level drift, north, from the Seneca shaft. The present hoist will be replaced with one having capacity to operate from 3500 ft., purchased recently from the East Norrie mine at Ironwood. The machinery already is on the ground. When sinking is under way cross-cuts will be put into the lode from time to time and stations for levels likely will be cut as the shaft deepens.

Much interest attaches to Mayflower's proposed work on the 14th level, where a drift shortly will be started in a northerly direction. Opening work on the 17th level will continue in the main drift south, where an encouraging 'showing' has been found. Operations on the 14th should be attended with fewer difficulties than at the greater depth, for barriers encountered below can be avoided through information obtained on the bottom level. The faults have been fairly well platted and these data will save much unnecessary drifting and cross-cutting on the 14th. For 500 ft. the main south drift from the 17th level has been in good milling ore, only recently cutting a fault which necessitated a cross-cut to the east to again pick up the vein.

The Winona Mining Co. has sold all of its standing saw-log timber near its property to the Pampa Land Co., a newly formed concern, which will establish a saw-mill and tie-mill and eventually a woodworking plant at Winona. The deal involves 20,000,000 ft. of timber. The Winona company has arranged to sell power to the new company and also will allow the new concern to use its electric railway, houses, and other equipment. The deal does not affect the mining rights of Winona, the company still retaining all of its lands and other assets of a mining nature. The establishment of this new industry is expected to make Winona a thriving settlement, which, since the shut-down of the mine, has been all but deserted.

MONTANA

Butte.—The North Butte Mining Co., although not producing copper, is maintaining the nucleus of its organization. Work is confined entirely to development on the 3000-, 3200-, 3400-, and 3600-ft. levels. Expenses are down to a minimum, shift-bosses in many instances acting as miners in carrying on development operations. On the 3400-ft. level of the Adirondack vein a drift 78 ft. long disclosed 38 ft. of ore averaging 4 ft. wide and assaying 4.3% copper and 3 oz. silver per ton.

The Edith May vein on the 3200-ft. level has been drifted on for a distance of 195 ft., of which 69 ft. was in ore of an average width of almost two feet, assaying 4.8% copper and nearly 3 oz. silver per ton. The 3400-ft. level on this same vein was drifted on for 194 ft., of which 88 ft. was in ore of an average width of 2.6 ft., assaying 8.1% copper and 4.3 oz. silver per ton. The 3600-ft. level of the Edith May was drifted on for 217 ft., 58 ft. being in ore assaying 14 6% copper and 6½ oz. silver per ton.

Helena.—The Howard shaft on the Drumheller-Woldson property, near Scratch Gravel, is down 270 ft. For a distance of more than 100 ft. below the 140-ft. level the shaft has been in ore, containing silver, copper, gold, and lead. Some is of shipping grade. The shaft is to be put down 300 ft. before cross-cutting.——At the Fairview mine a 20-in. vein of free-milling gold ore has been exposed.

The Carbon Hill mine, in the Grass Valley district, sent a car of silver ore this week to the East Helena smelter. The ore averaged $106 per ton.——The Surety and Consolidated lode-claims are under lease and option; a cross-cut is being run at a depth of 80 ft. for the purpose of finding an east-west vein that has not been opened heretofore.

NEVADA

Argentite.—Frank Taylor is sorting ore from the Argentite mine, under bond to the Natural Soda Products Co., for shipment to the Desert mill at Millers. The ore is coming from a drift at the bottom of a 100-ft. shaft.

Carson City.—A hearing is being held before the Public Service Commission of Nevada, designed to bring about a reduction in freight-rates on ore shipments from Nevadan

mines. The conference is attended by representatives of the railroad companies operating in Nevada, members of Chambers of Commerce, the Nevada Mine Operators' Association, and mining men from all parts of the State. According to officials of the U. S. Smelting & Refining Co., high freight-rates on coke and limestone used at the smelters make it impossible to reduce treatment-charges at this time. Mining men have contended that the present high rates have throttled mining in many Nevada districts, and that by making mining costs prohibitive in this way the railroads are losing large amounts of revenue.

Ely.—The Nevada Consolidated Copper Co., during the cessation in production, has been increasing its reserves of high-grade ore through development work. The new body of ore, in the Ruth mine, has averaged close to 10% copper to date; the ore will probably assay more than 6% as mined. Unofficial estimates place the amount of high-grade smelting ore in sight at about 500,000 tons.

Gerlack.—According to A. A. Codd, the recently finished milling plant of the Leadville Mines Co. will be improved so as to enlarge its capacity to at least 50 tons. A new shoot of ore was recently opened on the 350-ft. level of the mine, the ore averaging $30 per ton. Raises have been put up from the 300-ft. level for over 100 ft. Each shows about the same grade of ore. Considering that there are about 200 ft. of backs, this opens a big orebody.

Pioneer.—The 10-stamp mill of the Mayflower Consolidated company, which recently resumed operation, is now running smoothly. Development, carried on while the mill was being repaired, has opened a long shoot of ore in the Starlight claim, the average content being $20 per ton. Ore from the Starlight mine is delivered to the mill by a 1400-ft. tramway. W. J. Tobin is manager.

Reno.—George H. Bartlett, judge of the district court, has set December 8 as the time for the hearing of the suit brought against the Cash Boy Consolidated Mining Co., of Tonopah, by the Tonopah Extension Co. The Tonopah Extension charges that the Cash Boy has mined valuable ore from territory owned by the plaintiff and demands damages and costs. The suit is resisted by defendant corporation, which claims that all ore produced was taken from its own workings.

Royston.—Five feet of rich ore is exposed in the bottom of the shaft at the Betts lease on the Hudson mine; 10 tons of ore averaging $700 per ton was shipped recently to the MacNamara mill. The property is controlled by a new company of which Walker Brothers, of Salt Lake City, are the financial backers.

UTAH

Alta.—During October, the Alta Tunnel & Transportation Co. shipped 170 tons of ore, with a net smelter value of $6500. Recently additional teams have been secured, and it is expected shipments during the present month and December will be about 500 tons per month. The ore averages about $35 per ton, net.

Big Cottonwood Canyon.—Exploratory work at the property of the Cardiff Mining Co. has resulted in opening the richest ore ever found in the mine. The new discovery is on the 1100-ft. level. On the 600-ft. level, ore has been found several hundred feet south of the point where it was believed the mineralization extended. An ore-shoot from 4 to 15 ft. wide has been proved by a raise to extend upward for nearly 250 ft.——The gratifying results attending development at the Cardiff property has resulted in more aggressive exploratory work at the Howell, American Metal, Tar Baby, Price, and Reed's Peak properties. The American Metal Co. has completed preliminary work, such as the building of snowsheds, blacksmith-shop, and bunk-house. Work will be carried on throughout the coming winter. At the Price mine, a rich streak of ore recently found gave returns of 350 to 500 oz. in silver, 35 to 45% lead, and 10 to 11% zinc.

The State Securities Commission has granted permission to the Twin Peaks Mining Co. to sell 300,000 shares of stock. The company owns 11 claims upon which all assessment work has been done. The property is situated near the old Maxfield mine. The capitalization of the company is 1,000,000, of which 301,700 shares are outstanding. J. A. Kauffman is president.

Eureka.—C. E. Loose, who owns the controlling interest in the Grand Central Mining Co., has given an option on his entire holdings to Paul Hillsdale. Hillsdale is a son-in-law of Walter Fitch, of the Chief Consolidated Mining Co.; it seems certain that the option was secured for the latter company. The Grand Central is one of the oldest and best-known mines in the Tintic district. It is situated between the Mammoth and Centennial-Eureka properties, in the western part of the district. The main ore-channel in the Grand Central extends the full length of the property. The mine has produced ore to the value of about $10,000,000 and has paid $1,880,000 in dividends. Large quantities of low-grade ore have been developed that will average about $8 per ton. The mine has been opened to a depth of 2500 ft., with levels at intervals of 100 feet.

Road Up the Salmon River Valley, in British Columbia

Directors of the Iron Blossom Mining Co. have declared a dividend of 2½c. per share, payable on December 20. This will call for a payment of $25,000 and will bring the grand total of such disbursements up to $3,300,000. The last dividend paid by the company was in January 1920.

Several of the local mines, including the Tintic Standard

and Chief Consolidated companies, have been forced to curtail shipments of silicious silver ores, owing to the smelters being over-stocked. The notice to reduce shipments came at a time when the Tintic Standard was preparing to eclipse its past production records; shipments during the first week of November reached 81 carloads or about 4000 tons. During the week ending November 12, the Tintic Standard shipped 69 cars; Chief Consolidated, 38; Victoria, 12; Dragon, 12; Centennial-Eureka, 7; Eagle & Blue Bell, 7; Iron Blossom, 5; Colorado, 5; Swansea, 5; Bullion Beck, 2; Empire Mines, 2; Gemini, 2; Showers, 1; Sunbeam, 1. Shipments the preceding week totaled 191 cars.

The shaft at the Zuma mine has reached a depth of 950 ft. and is being sunk at the rate of 4 ft. per day. The bottom is now in a lime formation and sinking will be continued until the 1200-ft. level is reached.

Park City.—Suit his been filed in the United States District Court at Salt Lake City by Francesco Rospigliosi of New York to foreclose a mortgage for $30,000 on the property of the Glenallen Mining Company.

Ore shipments for the week ending November 19 totaled 1962 tons, of which the Judge allied companies shipped 934; Silver King Coalition, 603; and the Ontario, 425. The previous week's shipments totaled 1979 tons.

Stockton.—Operations have been resumed at the Muirbrook mine, which is owned by Mrs. Lena Larsen. The ore shipped from this property last year was high-grade; netting from $2000 to $2500 per car after deducting freight-, sampling-, and smelter-charges. Recently a body of high-grade ore was opened on the 200-ft. level, and development has also been resumed on the 500-ft. level. Mrs. Larsen is planning to start exploratory work on the Plono group of claims, consisting of 200 acres, adjoining the Muirbrook property. A boarding-house and blacksmith-shop will be erected immediately.

BRITISH COLUMBIA

Alice Arm.—An 18-ft. vein of ore averaging 34 oz. in silver per ton is being developed at the Moose group, in the Kitsault valley.

Kimberley.—The North Star mine has been re-opened. Work was suspended at the commencement of this year, when the Trail smelter ceased buying ore. Last year this mine shipped 6500 tons of silver-lead-zinc ore to Trail.

Nelson.—Some of the principal mine-owners in the Kootenay district met at Nelson on November 11, and former the Mining Association of eastern British Columbia, for the purpose of looking after the welfare of the mining industry in that part of the Province. The following provisional officers were elected, R. R. Bruce, president; Clarence Cunningham, vice-president; W. H. Burgess, secretary-treasurer; T. W. Bingay, S. G. Blaylock, W. A. Davis, S. S. Fowler, Douglas Lay, J. A. Madden, and W. T. McDowell, executives. R. R. Bruce and J. J. Warren were appointed a committee to proceed to Victoria to interview the officials of the Provisional government on mining matters generally and the present excessive rate of taxation in particular.——O. C. Thompson and W. B. Horton, who have a lease and option on the Utica mine, at Retallack, have cut two new ore-shoots in the lowest workings. One shoot gives 18 in. and the other 24 in. of clean ore. Good progress is being made on the 2000-ft. tunnel, which should cut the orebody at a point 350 ft. below the present bottom.——The Spokane Mining & Development Co. has struck a good body of copper ore at the Monarch group, near Beasley. A cross-cut has penetrated 7 ft. of ore, assaying 7% copper and $2.50 per ton in gold and silver. The hanging wall has not been reached.——The lessees of the Ottawa mine have shipped 26 tons of concentrate to the Trail smelter. L. H. Biggar, one of the lessees and manager, states that the concentrate was obtained from 700 tons of ore from the old waste dumps, which averaged 12 oz. of silver per ton. The ore is a dry silver ore. The concentrate contained 75% of the silver in the ore, and the cost of handling, concentrating, and shipping to the smelter was about $2 per ton of ore treated.

Trail.—During the first week in November, 10,307 tons of ore was received at the smelter. This is believed to be the largest tonnage received during any single week. The following mines contributed: Consolidated company's mines, 10,023 tons; Horn Silver, Similkameen, 43; Jessie Bluebird, Woodberry, 21; Grant, Woodberry, 2; Molly Hughes, New Denver, 27; Ottawa, Slocan, 26; Queen Bess, Almo, 33; Rambler-Cariboo, Rambler, 32; and Violet, Woodberry, 4. It is understood that the stock of lead at the smelter is now reduced to normal, while the surplus of spelter has been much reduced. It is likely, therefore, that the lead and zinc plants will be operated nearly at capacity until the end of the year. Only a comparatively small amount of copper is being refined, there being little ore or concentrate offered for sale.

Vancouver.—The Granby Con. M. S. & P. Co. has entered suit in the Supreme Court against the attorney-general of British Columbia. The plaintiff seeks for a declaration of its rights and liabilities under the British Columbia Taxation Act and for a declaration to the effect that taxes for which it is liable are not due until January 2, 1922, and do not become delinquent until December 31, 1922.

MEXICO

El Tigre.—The owners of the El Temblor are planning to re-open the mine and have sent Tom Frasier, of Patagonia, Arizona, to make a preliminary report on the condition of the property. A great deal of rich gold-silver ore has been taken out since the mine was shut-down, but so much water was developed that further operations were impossible.

Moctezuma.—O. L. Neer and sons are prospecting the Cerro Gordo property south-west of here; they are reported to have found ore. This mine was a bonanza before the revolution, and since then considerable high-grade has been extracted. Several hundred feet of new development has been necessary in order to put the mine in position to ship. The ore carries about 500 oz. silver and some lead and copper.

Nacozari.—A lively contest took place at the Cumpas Mining Agency when the old Good Enough property was thrown open for denouncement. This mine, which is about 12 miles east of here, has had several pockets of very rich gold ore. Smith & Whitehead, of Douglas, won the claim over five other contestants in the lottery that decided the ownership.——Crawford and Odell, of Ray, Arizona, have taken a lease and option on the Pinito mine recently denounced by George Bartlett and others. They expect to build a cyanide plant.

Torreon.—The re-opening of the smelters in this vicinity has caused renewed activities in the famous Sierra de Ramirez, near Symon station, about 90 miles south of Torreon. The formation of this mountain is pure limestone and the minerals are found in blanket-veins which have produced some big bonanzas of silver-lead ore, easily treated. Up to the present time they have been superficially developed by adits. No vertical shafts have been sunk to any great depth in order to ascertain the contents of the lower stratum. It is generally believed that rich orebodies will be discovered by sinking. The mines contain no water, and there will be no necessity for pumps.

There is a good wagon-road from Symons station to the mountain. It costs about ₱3.50 per ton to freight the ores from the mines to this or other near stations on the National Railways main line. An automobile makes the trip in about thirty minutes over a good hard road. The miners in this district receive from ₱1 to ₱1.25 per day. The principal mines are Calaverita, San Pedro, San Agus-

tin, La Bola, Santa Teresa, Providencia, La Blanca, Las Animas, La Humidad, La Esmeralda, La Florida, California, San Andres, Plateros, El Patrocinio, San Pablo, Cristales, San Rafael, and San Jaime.

ONTARIO

Gauthier Township.—A discovery considered important has been made on a location between the Bidgood at Kirkland Lake and the Argonaut in the Beaver House Lake district. The vein is about 3 ft. wide and shows a high proportion of iron and copper sulphides and some visible gold.

Kirkland Lake.—The Wright-Hargreaves has declared a dividend of 5% to be paid January 1 to shareholders of record December 17. It is stated that the dividend, which calls for a distribution of $125,000, is from the surplus earnings since January 1 last.——Work is progressing favorably on the Queen-Lebel, where stripping and trenching have disclosed several promising veins. Vein No. 1 has been uncovered for 800 ft. and shows a width of 4 ft. with gold content of $20 per ton. A. C. Stevens is in charge.

Lightning River.—At the annual meeting of the Lightning River Gold Mines, W. J. Lucy, president, stated that 12 veins had been trenched and stripped, giving evidence of ore. The directors have decided to proceed with the sinking of a shaft.

Porcupine.—An estimate of the gold production of Porcupine and Kirkland Lake, based on the operations of the last two months, places the total at $1,584,000 per month, or at the rate of about $19,000,000 per year. The list, comprising seven producing mines, is headed by the Hollinger Consolidated, with a monthly tonnage of 110,000 tons of ore, of the value of $1,000,000, the Dome Mines coming second, with a tonnage of 32,000 tons, valued at $240,000. There are approximately 2600 men employed in the producing mines of the Porcupine district and 500 in the Kirkland Lake area. These figures do not include properties in the development stage, which furnish employment to between 300 and 400 men.

A dispute has arisen between the Northern Canada Power Co. and the managers of the leading mines. The company has offered to proceed with further development to satisfy the increase in the requirements of the mines anticipated from projected expansions, provided the mining companies will state clearly what their additional needs will be, and agree to take such increased amounts of power. The Hollinger Consolidated and the McIntyre, however, having intimated that they may proceed to develop power on their own account, the Power company is not disposed to take further action looking to an increase in the supply until some definite understanding is arrived at.

South Lorrain.—The Keeley during October produced 102,819 oz. of silver. Since milling operations were commenced in June the total production amounts to 263,000 oz. No. 6 vein, which has been drifted on for 32 ft. at the 418-ft. level, shows high-grade ore averaging 4000 oz. per ton over a width of 12 inches.

YUKON TERRITORY

Dawson.—Development work is to continue all winter on a number of the properties at Mayo. Electric drills are to be used throughout the closed season on the properties of the Yukon Gold Co., and the Bradley interests, associated with the Alaska Treadwell Co., will continue prospecting at their new camp, Keno Hill. Two shafts, 300 ft. deep, are to be sunk and connected on four levels. The Yukon Gold Co. is opening a vein of galena. The ore is high-grade, said to average well above 200 oz. silver per ton. Sixty additional claims have been staked within a month on Galena hill, where recent promising finds are reported. The winter work of hauling ore from Keno Hill to Mayo Landing for summer shipment down the river is now under way.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

John A. Burgess is at Carter, Nevada.

J. Parke Channing was at Miami early this month.

A. H. Means is at Pine Knot, San Bernardino county.

Joseph Errington has returned to Oakland from British Columbia.

J. C. Buchen, formerly at Miami, Arizona, is at Oakland, California.

Dwight L. Sawyer, recently at Sneffels, Colorado, is at Salt Lake City.

Horace V. Winchell has been spending some time in Utah on professional work.

W. Earl Dunn is now with the Midway Petroleum Co., at Montebello, California.

C. B. Lakenan visited Salt Lake City recently, and then came to San Francisco.

Arthur Thacher is attending the meeting of the Denver section of the Institute.

T. Bessler, recently at Sumpter, Oregon, is now at Downieville, California.

A. M. Chamberlain is at Mina La Constancia, Amori, Colombia, South America.

J. Raick, of Belgium, was recently at Anaconda, Montana, and is now at Kellogg, Idaho.

W. G. Anderson, recently at the Dolores mine, Chihuahua, Mexico, is now at Stockton, California.

Roy H. Elliott has been inspecting gravel deposits near Martinsville, in Trinity county, California.

I. M. Wheeler, formerly general superintendent of the smelter at Great Falls, is now at Liege, Belgium.

H. L. Tedrow, formerly with the Metates Mining Co. at Mazatlan, Sinaloa, Mexico, is now at Los Angeles.

Wilbur H. Grant has been engaged on geological work in the Idaho Maryland mine at Grass Valley, California.

Henry F. Crittenden, of Salt Lake City, has accepted a position on the editorial staff of the 'Tonopah Mining Reporter'.

Kuno B. Heberlein, formerly general manager for the Peñoles Mining Co., of Mexico, has opened an office at 42 Broadway, New York.

C. H. Brandes, formerly chief mechanical engineer and general purchasing agent for the American Metal Co., has opened an office at 42 Broadway, New York.

Walter L. Reid, who has been superintendent of the cyanide plant of the Smuggler Union company at Telluride, Colorado, is now with the United Comstock Mines Co., at Gold Hill, Nevada.

Andrew Rocca died at Calistoga, California, on November 14. He was born at Genoa, Italy, on October 8, 1838, and on his fifteenth birthday sailed for California, landing in San Francisco in January 1854. He went to Bear valley, Mariposa county, and engaged in placer mining, which he followed from 1860 to 1867. In 1869 he became superintendent of the Golden Rock Water Co. In June 1876 he went to Spring creek, two miles from Shasta, and built eight miles of ditches and flumes. He then installed two six-inch hydraulic giants and began operations. In six weeks the debris filled the Sacramento river to such an extent that operations were suspended, and Rocca came to San Francisco. In the same year he became superintendent of the Great Western Quicksilver Mining Co. About 1900 he bought the American quicksilver mine, which he managed until a short time ago, when he was obliged to give up active work on account of his health.

THE METAL MARKET

METAL PRICES

San Francisco, November 22

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.50
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$80
Platinum, 10% iridium, per ounce	$92
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

November 21.—Copper is active and higher. Lead is quiet and firm. Zinc is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 15	67.25	38.37	Oct. 10	70.73	42.06
" 16	67.50	38.37	" 17	72.97	42.57
" 17	68.75	38.75	" 24	70.64	40.52
" 18	69.00	39.00	" 31	70.04	40.25
" 19	69.75	39.25	Nov. 7	69.46	39.93
" 20 Sunday			" 14	67.28	38.85
" 21	69.00	39.25	" 21	68.54	38.83

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Nov. 15	13.00	Oct. 10	12.64
" 16	13.12	" 17	12.80
" 17	13.25	" 24	12.69
" 18	13.25	" 31	12.68
" 19	13.25	Nov. 7	12.75
" 20 Sunday		" 14	12.88
" 21	13.25	" 21	13.19

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12 46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	16.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 15	4.70	Oct. 10	4.70
" 16	4.70	" 17	4.70
" 17	4.70	" 24	4.70
" 18	4.70	" 31	4.70
" 19	4.70	Nov. 7	4.70
" 20 Sunday		" 14	4.70
" 21	4.70	" 21	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Nov. 15	5.22	Oct. 10	4.74
" 16	5.20	" 17	5.12
" 17	5.20	" 24	5.14
" 18	5.15	" 31	5.07
" 19	5.15	Nov. 7	5.18
" 20 Sunday		" 14	5.23
" 21	5.15	" 21	5.18

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Oct. 25	42.50	Nov. 7	40.00
Nov. 1	42.00	" 15	40.00
		" 22	40.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

GOLD POSITION OF THE UNITED STATES

It seems an anomaly that 22 United States senators should urge the passage of a bill providing a bonus for newly-mined gold when the United States has the largest gold monetary stock in its history, as well as the largest in the world. The purpose of the bill, is, of course, to assist the gold mining industry, hard hit by rising costs of operation. These same factors which worked to depress gold mining in this country, increased cost of labor and materials as against a fixed price for gold, also served to curtail gold mining in other countries, but there is an offsetting factor affecting mines in foreign countries which has to some extent afforded relief. That is the foreign exchange situation, says a dispatch in the 'Boston News Bureau'.

With the American dollar commanding a premium, American bankers have been able to buy the world's gold production at a 'premium' as measured in the money of the seller. This situation has helped to maintain production of gold in mines outside of the United States, as the premium realized on sale of gold has tended to offset increase in cost of operations.

The following table shows the world's production, the production in the United States, and the proportion from the United States for each year since 1910.

	Gold production in the world	Gold production in the United States	Proportion produced by United States %
1920	$338,000,000	$51,186,900	15.1
1919	365,166,077	60,333,400	16.5
1918	383,605,552	68,646,700	17.9
1917	419,422,100	83,750,700	19.9
1916	444,176,500	92,590,300	20.8
1915	468,724,918	101,035,700	21.5
1914	439,078,260	94,531,800	21.5
1913	459,939,900	88,884,400	19.3
1912	466,136,100	93,451,500	20.0
1911	461,980,500	96,890,000	20.9
1910	455,239,100	96,269,100	21.1

Notwithstanding decrease in output the gold stock of the United States has been steadily rising the past year, due to large shipments in connection with settlement of trade balances and foreign debts. Stock of gold in the United States on October 1, according to estimates of Director of the Mint, was $3,453,008,914, a new high record to date. The stock of gold in the United States on various dates follows:

Oct. 1, 1921	$3,453,008,914	Jan. 1, 1915	$1,815,976,319
Jan. 1, 1921	2,784,834,427	" 1914	1,924,360,506
" 1920	2,787,714,306	" 1913	1,878,577,122
" 1919	3,080,510,001	" 1912	1,797,000,916
" 1918	3,040,439,343	" 1911	1,708,828,297
" 1917	2,864,841,650	" 1910	1,638,108,821
" 1916	2,312,444,489		

MONEY AND EXCHANGE

Foreign quotations on November 22 are as follows:

Sterling, dollars:	Cable	3.98½
	Demand	3.99
Franc, cents:	Cable	7.15
	Demand	7.17
Lira, cents:	Demand	4.15
Marks, cents:		0.37

Eastern Metal Market

New York, November 16.

A holiday on Tuesday, election day, and another on Friday, Armistice Day, have interfered with the usual course of the market, but the tone of all of them is good and business is active in some.

Buying of copper is of considerable proportions and prices have advanced.

Demand for tin is fair but spasmodic.

The lead market continues moderately active and firm.

Quietness pervades the zinc market with values steady.

IRON AND STEEL

Features of the week having a direct bearing on the iron and steel market have been a slowing-down of buying and an easing-off in prices, with some reductions in mill-operations. The remaining six weeks of the year, it is evident, will make a better showing in mill-output than in new business put on the books. Buying of cars is still the most promising factor in the new business.

The composite prepared by 'The Iron Age' for finished steel, now at 2.113c. per pound, is 25% above the average for the ten years before the War. The pig-iron composite price has diminished to $19.81 per ton. Unlike the price of steel, which has been gradually descending since July 1920, the pig-iron composite reached a minimum in the middle of August at $18.51, but rose again to $20.10 in September, with a subsequent downward change of only 29c. in the seven weeks.

COPPER

The market is more active and higher and its strength seems to be augmented slightly every day or two. Values are from ¼ to ⅜c. higher than a week ago with electrolytic quoted for early delivery (30 days) at a minimum of 13c., refinery, or 13.25c., deferred, with the prospect of this disappearing any day. Some large sellers are quoting not less than 13.37½c., delivered, and some not quoting, having sold as much as they desire at present. Inquiries are numerous for first quarter with some sellers asking not less than 13.50c., delivered, and others higher. Sales for foreign consumption are good with as high as 13.37½c. f.a.s. obtained for some lots. England, Germany, and the Far East are buyers. Japan is reported to be inquiring for 1000 tons. Statistically the market is stronger than in many weeks. It appears that deliveries into consumption in October are now placed at 110,000,000 lb., which is about 40,000,000 more than the monthly average up to that time. With sales last month at 140,000,000 lb. and production not over 40,000,000 lb. per month, the statistical position is regarded as strong. One seller looks for 15c. copper this year, but admits it would not be good for the market.

TIN

The market is only moderately active, sales having been confined to one day the past week. On Thursday, November 10, late in the day, a buying movement started which resulted in the sale of at least 300 tons of Straits tin. About two-thirds of this went to consumers; the positions involved were actual spot and future deliveries, the intermediate being neglected as in the recent weeks. The buying movement started with an inquiry from the interior for 100 tons for actual spot delivery and then other buyers appeared. Yesterday and today demand was inconsequential. Spot Straits, New York, was quoted yesterday at 28.50c., New York. Prices have hovered between 28 and 29c. the past week, due largely to the high value of the pound sterling. Arrivals thus far this month have been 1505 tons with 3475 tons reported afloat.

LEAD

The principal item of news bearing on the market's future course is the announcement that freight-rates from East St. Louis to the seaboard will be reduced from 49c. per 100 lb. to about 35c. on or about December 10. This will enable Western producers to more easily compete in the Eastern market. Demand continues steady at prevailing quotations of 4.70c., New York, or 4.35 to 4.40c., St. Louis. The leading interest continues to quote 4.70c., both New York and St. Louis.

ZINC

The same thing applies to zinc as to lead in regard to a reduction in freight-rates, as explained in the preceding paragraph. The reduction and other conditions are understood to be identical for zinc as for lead, though no official announcement has been made. Buying has slackened until the market is exceedingly dull. The market for prime Western is quotable at 4.70 to 4.75c., St. Louis, with the amount of metal available below 4.75c. very small. Consumers bought well in October covering most of their requirements for a while and producers are not eager sellers, having sold well into their November output last month.

ANTIMONY

In an inactive market quotations have eased to 4.65c., New York, duty paid, for wholesale lots for early delivery with jobbing lots ⅛ to ¼c. higher.

ALUMINUM

Although the quotation of the leading producer of virgin metal, 98 to 99% pure, continues at 24.50c. per pound f.o.b. plant, for wholesale lots for early delivery, it is believed that it is meeting importers' quotations for the same grade at 17 to 18c., New York, duty paid.

ORES

Tungsten: Conditions are unchanged, the market remaining dull and featureless. Quotations are nominal at $2.50 per unit upward, depending on grade of ore and other specifications. One seller reports the sale of a small lot at $3 per unit.

Molybdenum: In an inactive market quotations continue nominal at around 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: The condition in this market is illustrated by the fact that one seller cannot get a bid from a consumer on a quantity of foreign ore for shipment from the East. Quotations are nominal at 20c. per unit, seaboard.

Chrome: No demand is reported and quotations are nominal at $20 to $26 per net ton, c.i.f. Atlantic seaboard, for foreign ores of standard quality. Rhodesian ore is quoted at $22 per ton, Atlantic seaboard, for prompt shipment.

FERRO-ALLOYS

Ferro-manganese: No sales or inquiry are reported, except that the Steel Corporation is understood to have sold recently 1200 tons at around $60, Pittsburgh.

Spiegeleisen: Outside of inquiries for a few carload lots the market is inactive at $25 to $26, furnace, for the 20% grade.

Ferro-tungsten: Inactivity is reported with quotations unchanged and nominal at 40 to 45c. per pound of contained tungsten in the domestic alloy and at 50c., duty paid, seaboard, for the foreign.

Ferro-silicon: The 50% alloy is a little firmer at $58 to $60, delivered, with a moderate inquiry reported.

Ferro-chromium: Standard alloy is quoted all the way from 10 to 14c. per pound of contained chromium.

Book Reviews

Editorials and Editorial-Writing. By Robert W. Neal. 398 pp. Published by the Home Correspondence School, Inc., at Springfield, Massachusetts. Price, $3.

This is a compendium of representative writings from the editorial columns of the daily press and the leading weekly journals, together with a small measure of comment by Mr. Neal. At the end of each collection of editorials of a given kind are 'exercises', in the shape of questions that a student is supposed to answer. As a student of a fascinating subject—that of editorial writing—I have read the book with keen interest. The excerpts do not provoke much curiosity or interest, because the average editorial depends for its value chiefly on timeliness; many of them are typical of the poor style that characterizes the average periodical; some of them are so poor as to be excused only on account of the compiler's desire to make his compilation thoroughly representative. The part of the book that caught my attention was Chapter I of Part III, in which 'Ideals, Sidelights, and Hints' are recorded in the form of quotations from the utterances of notable editors and sundry publishers. Here again there is a curious jumble, for Thomas Carlyle and Oswald Villard are found in juxtaposition; likewise Calvin Coolidge and John A. Hill. Reference is made to the passing of the era of intensely personal journalism, typified by Greeley and Watterson, and with it the over-emphasis on partisan politics. Time was when 90% of the editorial space was given to party politics of a narrow-minded type. The lowest point reached by the editorial page was at the beginning of the century; after the year 1900 it improved by being made less personal. H. W. Brundige, a Los Angeles editor, says: "On the whole the editorial page of the present is less mercenary, less partisan, less abusive than that of a generation ago". The Great War helped to improve the status of the editorial page, which attracted increased attention from the readers because the information given by the editors on the economic and political crises growing out of the War were interesting, and when the United States joined the Allies the readers became more thoughtful, so that they paid closer attention to the great issues of the day. Charles H. O'Neill, of Walla Walla, says: "The editorial page of a newspaper is pregnant with a greater responsibility and is a more potent force for good or evil than are the news columns, and, in my opinion, is one of the greatest forces for good or evil in the world". One of the functions of the editorial is to give words to the reader's thought, says James D. Symon, of London. The plain man likes to have his ideas put into fine phrases for him, and when he reads an editorial that is to his taste he slaps his knee and exclaims, "That's exactly what I've been thinking all along". Tom Dillon, of Seattle, remarks: "An editor may prefer being right to being popular, or he may prefer being popular to being right. Of the two it is easier to be popular, and in the majority of cases it is more profitable". As to the control, H. N. Rickey, of the Scripps agency, says: "Our experience has taught us that there is just one way to get and hold the confidence of enough readers to make our newspapers successful. This is for the editorial end to control". These are brave words. Frank S. Baker, of Tacoma, is of the opinion that "the editorial viewpoint is nine-tenths of the newspaper. There was a period in the history of American journalism when the expression of any such belief would have been out of joint with the times, if not unwarranted. Nevertheless, the importance of the editorial viewpoint persisted, and once more the editorial is re-asserting itself, coming again into its own". This is confirmed by A. C. Broughton, of St. Louis, who asserts that "the only good way to sell advertising now is through the editorial page. An editor must know of what he speaks. Confidence in his paper follows, and public confidence in a newspaper gives it its greatest value as an advertising medium". To this H. F. McDougal, of Marysville, Missouri, adds: "If you don't have good editing you can't have a good business proposition". The late John A. Hill advocated a "soul department"; our mealy-mouthed gentleman of 'The Nation' asserts that "no commercial returns, however great, can compare with the moral satisfaction attained by the editor whose lance is ever ready for the public enemy, however armored". How about the national enemy during the War, Mr. Villard? These citations, brief as they are, will weary the reader, I fear, as the originals, of greater length, wearied me. However, some true notes are struck, as by Joseph Blethen, of the Seattle 'Times'; he says: "A paper which would suppress news or deceive its readers at the command of any advertiser, or group of advertisers, would speedily become a hand-bill". It is the publisher's business to take the advertiser's money and therewith secure the best editorial talent with a view to causing the paper to be read, and thereby giving the advertiser a good medium of publicity. "It is the business of an editorial writer", says Osman C. Hooper, of Ohio, "to make himself read, and it may be set down at once that if he is not read, he is a failure . . . To knowledge and spirit he must add a certain literary skill. He must have the ability to present a matter in attractive guise, for it is no less the business of the editorial than it is of the news story to be interesting". As to the style, Dante Barton, of the 'Kansas City Star', says: "The problem of newspaper editorial English is, to preserve a good style and yet reach the large class of persons who do not consciously go in for style . . . The great mass of newspaper readers do, consciously or unconsciously, like a literary quality in their editorial pages". In regard to signed editorials, James M. Lee, formerly of 'Judge', says: "The man who writes the editorial frequently accepts ideas from every member of the staff in his presentation of the subject, and he would be guilty of plagiarism if he should attach his name to the editorial. The editorial 'we' is the real author of the editorial". Indeed, the members of the staff should collaborate so that the writing of any one of them gains from the information and criticism contributed by others. That is the meaning of the pontifical 'we'. One more quotation: Frank S. Baker, of Tacoma, says that a newspaper is "a public trust". That, it seems to us, is the best saying in this compendium.—T. A. R.

Chemistry and Civilization. By Allerton S. Cushman. 151 pp., ill. Richard G. Badger, Boston. For sale by the 'Mining and Scientific Press'. Price, $2.50.

The contents of this book formed a series of lectures that were delivered at the Wagner Free Institute of Science, at Philadelphia. The author, who is well known for his work on the rusting of iron and steel, as well as in connection with potash fertilizers, is a director of the Institute of Industrial Research. The book is divided into six sections. In the first, the author deals with cosmic chemistry, the formation of the world in its present state, and the evolution of organic life. The connection between modern industry and primordial life is described, leading up to the work of the alchemists. A particularly interesting feature of the section is the study of the phlogistonists—Priestly, Stahl, Scheele, and Cavendish. The influence of the American and French revolutions in making chemistry the servant of man, is emphasized; and due regard is paid to the work and investigations of Lavoisier and Dalton. A notable attraction of the book is the historical description of chemical progress during the 18th and 19th centuries, coupled as it was with the work of Benjamin Thompson, Humphrey Davy, Cavendish, Faraday, and Liebig; and influenced, as it also was, by the foundation of associations of learned men, such as the

Royal Institution of Great Britain and the Royal Society. Subsequent sections deal more directly with the connection between chemistry and modern commercial effort. Improvement in the alkali, and iron and steel industries are described, and attention is paid to ceramics, and the manufacture of portland cement, benzine, coal-tar, and medicinals, as well as to products that can be made synthetically, such as indigo, camphor, and rubber. The concluding sections deal with the subjects of chemistry and the War, radium, and the modern features of chemical achievement, including a study of colloids, the liquefaction of gases, the story of helium, the 'cracking' of petroleum, and the promise of the future as compared with the achievement of the past.

Hayes' Handbook for Field Geologists. Third edition by Sidney Paige. 166 pp., ill. John Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price, $2.50.

In 1898 a 'Handbook for Field Geologists' was published for distribution to members of the U. S. Geological Survey. Requests for copies of the book came from so many persons outside that organization that the first edition of this work, by C. W. Hayes, who was then Chief Geologist, was prepared. The Survey Handbook was used in the preparation, only those instructions that applied to members of the government survey having been omitted. The present edition, the third, has been prepared in response to a continued demand for a handbook on general geologic practice; the author of the revised treatise is the geologist in charge of the division of geology of the Survey. No alterations have been made in the fundamental plan of the book, although some minor rearrangements have been effected. A brief mineralogy, prepared by Dr. E. S. Larsen, has been added. Methods of geologic work with the plane-table have been revised, and certain recently developed tables for useful calculation in stratigraphy have been added. Some of the schedules have been revised in accord with developments of the science. The contents are as follows: Part I. General practice. Prerequisites for a field geologist. Classification of geologic surveys. Relations to the public. Preparation for field work. Field outfit. Field observations. Estimates of distance. Horizontal measurements. Angular measurements. Vertical measurements. Determination of thickness of beds. Determination of depth of beds. Determination of faults. Form of outcrop. Tables and formulas. Written notes. Map notes. Graphic notes. Traverse notes. Plane-table notes. Profile notes. Land classification surveys. Mine surveys. Collections. Chemical analyses. Geological nomenclature. Part II. Instructions for special investigations. Purpose of schedules. Description and interpretation of land forms. Petrologic observations. Igneous rocks. Sedimentary rocks. Metamorphic rocks. Structural geology. Glaciers and glacial deposits. Investigation of metalliferous deposits. Appendix.

Analytical Chemistry. Vol. I. Qualitative Analysis. By F. P. Treadwell and W. T. Hall. xvii + 597 pp., ill. John Wiley & Sons, New York. For sale by the 'Mining and Scientific Press'. Price, $4.50.

This is the fifth English edition of a text in German that was written by an American who taught for many years at Zurich. The first edition appeared as an English translation by one who had been teaching analytical chemistry for only three years at the time. Since the fourth English edition was published, the sales of the book have almost doubled, and this has encouraged the making of further alterations. The general treatment has been maintained. The tests for the rarer elements and for the less common acids have been amplified, new reactions being given for nearly every element. The schemes of systematic analysis have been changed in some places, and new procedures have been introduced. The International Atomic Weights for 1921 have been included. The contents are as follows: Part I. General Principles. Part II. Reactions of the metals: Group V, Alkalies; Group IV, Alkaline earths; Group III, Group II; Group I. Part III. Reactions of the acid constituents. Division of the acids into seven groups. Part IV. Systematic analysis. Part V. Reactions of some of the rarer metals.

Recent Publications

Petroleum Laws of All America. By J. W. Thompson. Bull. 206, Bureau of Mines, 1921. 645 pp.

Feldspar in 1919. By L. M. Beach. II:27, U. S. Geological Survey, 1921. 2 pp. From Mineral Resources of the United States, 1919, Part II.

Cement in 1919. By Ernest F. Burchard. II:30, U. S. Geological Survey, 1921. 18 pp. From Mineral Resources of the United States, 1919, Part II.

Fuel Briquets in 1920. By W. F. McKenney. II:11, U. S. Geological Survey, 1921. 3 pp. From Mineral Resources of the United States, 1920, Part II.

Strontium in 1920. By George W. Stose. II:12, U. S. Geological Survey, 1921. 3 pp. From Mineral Resources of the United States, 1920, Part II.

The Determination of Oxides of Nitrogen. By V. C. Allison, W. L. Parker, and G. W. Stone. Technical Paper 249, U. S. Bureau of Mines, 1921. 13 pp.

Coke-Oven Accidents in the United States During the Calendar Year 1920. By William W. Adams. Technical Paper 293, Bureau of Mines, 1921. 32 pp.

Lime in 1919. By G. F. Loughlin and A. T. Coons. II:31, U. S. Geological Survey, 1921. 14 pp. From Mineral Resources of the United States, 1919, Part II.

Sodium Compounds in 1920. By Roger C. Wells. II:14, U. S. Geological Survey, 1921. 12 pp. From Mineral Resources of the United States, 1920, Part II.

Stone in 1919. By G. F. Loughlin and A. T. Coons. II:32, U. S. Geological Survey, 1921. 32 pp. From Mineral Resources of the United States, 1919, Part II.

Antimony in 1920. By Frank C. Schrader. I:8, U. S. Geological Survey, 1921. 12 pp., diagram. From Mineral Resources of the United States, 1920, Part I.

The Metal Mines of Washington. By Ernest N. Patty. Bull. 23, Washington Geological Survey, 1921. 366 pp., ill., diagrams, index, glossary. Olympia, Washington.

Zinc in 1919. By C. E. Siebenthal and A. Stoll. I:24, U. S. Geological Survey, 1921. 12 pp., diagram. From Mineral Resources of the United States, 1919, Part I.

Iron Ore, Pig Iron and Steel in 1919. By Ernest F. Burchard. I:23, U. S. Geological Survey, 1921. 32 pp. From Mineral Resources of the United States, 1919, Part I.

Orthaulax, a Tertiary Guide Fossil. By C. Wythe Cooke. Professional Paper 129-B, U. S. Geological Survey, 1921. 15 pp., ill. From Shorter Contributions to General Geology, 1921.

The Mineral Resources of Washington. With Statistics for 1919. By Ernest N. Patty and Sheldon L. Glover. Bull. 21, Washington Geological Survey, 1921. 155 pp., ill, index, map. Olympia, Washington.

Investigations of Zirconium with Especial Reference to the Metal and Oxide. Historical Review and Bibliography. By J. W. Marden and M. N. Rich. Bull. 186, Mineral Technology 25, Bureau of Mines, 1921. 152 pp., ill., index.

Pyrite at the Haile Mine, Kershaw, South Carolina. With a Note on Pyritization at the Brewer Mine near Jefferson. By Frank C. Schrader. Bull. 725-F, U. S. Geological Survey, 1921. 15 pp., map. From Contributions to Economic Geology, 1921, Part I.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A SIGNIFICANT COINCIDENCE

The Nordberg Manufacturing Co., of Milwaukee, has issued a unique publication called 'Nordberg and the Mining Industry'. The title page is captioned 'A Significant Coincidence'; it says:

About a year ago the 'Mining and Scientific Press' issued a booklet to show the buying influence of some of its subscribers. Two hundred and fourteen of them control the destinies of twenty mines whose aggregate capitalization is more than $400,000,000.

Of the twenty mining properties illustrated in the booklet, seventeen of them are large users of Nordberg apparatus. When it is realized that the twenty mining companies were selected only with the idea of showing the kind of men who read the publication, the significance of the fact that seventeen of the mines use Nordberg apparatus, is at once apparent.

Fifteen of the twenty plates used in printing the booklet were borrowed from the publisher and are reproduced on the following pages. The list of subscribers has been replaced with short descriptions of the Nordberg apparatus used in the mines illustrated. Two of the seventeen plates have been omitted—one, the plate showing the Braden Copper Co. property, and two, the plate of the Montezuma Copper Co. property. The latter company is controlled by the Phelps Dodge Corporation and most of the Nordberg apparatus which it uses is mentioned on page 11, together with other Nordberg equipment in the several Phelps Dodge properties.

What better proof of Nordberg's pre-eminence in the mining industry could be desired—seventeen out of twenty leading mines selected by a disinterested party? Truly a significant coincidence.

CRAWLING-TRACTOR CRANE

The type BC 'Industrial' crawling-tractor crane, illustrated in the accompanying photograph, manufactured by the Industrial Works, Bay City, Michigan, has been developed to meet the need for a full-revolving tractor crane which can be operated independently of rails. The crane is built in two types—the type BC, with a capacity of 20,000 lb. at 12-ft. radius, equipped with continuous crawling-tractor belts, and the type BT, with a capacity of 18,000 lb. at 10-ft. radius, equipped with four broad-gauge tractor wheels.

Bay City Crawling-Tractor Crane

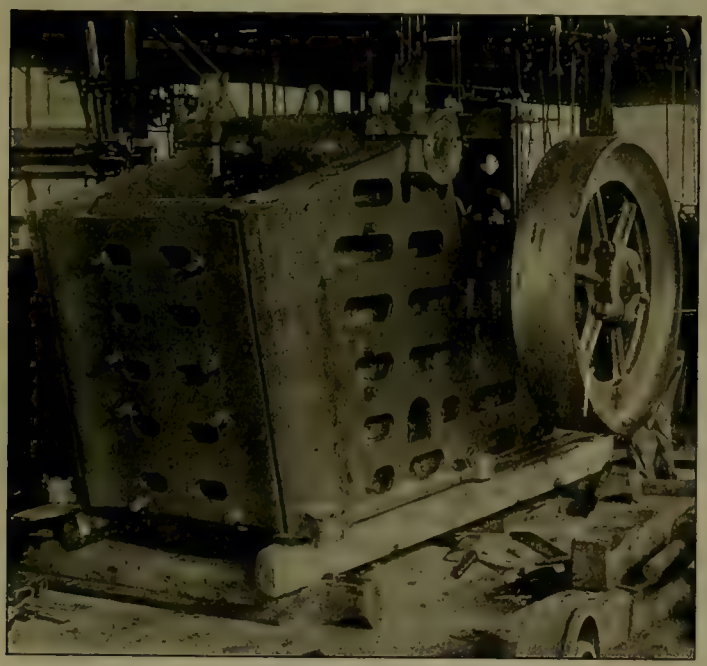
The maximum utilization of space is realized with the use of these cranes because their field of usefulness is not limited by railroad tracks, as is the case with the railroad crane. Having exceptionally large capacities in ordinary lifting, they prove a valuable adjunct in those many erection jobs that are inaccessible to the railroad crane. They can be equipped to handle a hook and block, grab-bucket, drag-scraper bucket, electric lifting-magnet, shovel-dipper, and pile-driver with drop-hammer.

Operation is by means of an internal-combustion engine, which has the advantage of being always ready for immediate use. When not in operation no fuel is consumed and it is not necessary, as often with a steam-operated machine, to have a licensed engineer as operator. The steering of the crane while propelling is accurately controlled by the

operator, from his position in the revolving upper works, by manipulation of the friction clutches and brakes controlling the motion of each tractor-belt. By means of these clutches and brakes either tractor-belt can be readily and instantly disconnected from the motor while the other belt continues traveling at the normal rate of speed. The disconnected tractor-belt can be held stationary by applying the brake, can be allowed to coast with the brake and clutch both disengaged, or the clutch can be allowed to slip, thus allowing operator to turn as sharp or as wide a corner as he may select. All the clutches, brakes, and lever mechanism for steering are in the revolving upper-works, where they are simpler and much more accessible than when a portion or all of them are on the car-body.

JAW-CRUSHER FRAME OF A NEW TYPE

The use of Blake-type jaw-crushers of increasingly large sizes has led to the design of these machines with sectional frames. The reasons are that the single-piece frame is unwieldy, and also that it is difficult to make such a frame that will withstand the great crushing-strains developed in the breaking of large pieces of hard rock. The rigidity of a single-piece casting, particularly at the corners, has always been a source of trouble, excessive strains resulting in a breaking away at one of these points.



New Sectional Jaw-Crusher Frame

In an effort to obviate both of these difficulties the sectional or four-piece frame was developed. Ordinarily the four-piece frame is designed so that the side-frames are grooved and the end-frames mortised into them. Bolts through the end-frames, and secured outside the side-frames, hold the parts together. It is difficult to say definitely which of these alternatives, in so far as breakage is concerned, is the worst. The solid frame is absolutely rigid, and the mortised construction provides a sharp corner in which the slightest flexure of the end-frame develops a crack which soon results in a breakage of the side-frame. To further promote this sort of breakage, the ordinary crushing-strains are not distributed along the central axial plane of the side-frames, but are to one side, or are overbalanced.

This breakage is not unusual, but rather common. The technical press abounds in descriptions of clever methods of repairing broken jaw-crusher frames, and promoters of various methods of welding have advertised examples of repairs made on machines of this type. The difficulty has been general, among all manufacturers; it is the result of faulty design. This cannot be cured except through a correction of design, excluding the features that have been definitely shown to be faulty.

Recognizing the basic error of existing designs of this kind, the engineers of the Kennedy-Van Saun Mfg. & Eng. Corporation set about the development of a new type of crusher-frame that would get away from this 'corner' weakness and make a particularly strong point out of what has always been a particularly weak one. The result is the Kennedy hinge-joint frame. In this machine the extremities of the side- and end-frames are made circular in section, the end-frames fitting into the side-frames, the whole joined by a heavy steel pin. In this design the crushing-strains are balanced through the side-frames, taking advantage of all the strength of the metal. Being made of box-section steel castings, they will resist any strain placed upon them in normal crushing operations. There are no corners or edges, and any slight flexure of the end-frames under heavy crushing has no effect whatever on the side-frames, since the pin allows enough freedom to relieve any such movement without transmitting it to the side-frames.

Rigidity of the essential parts of the frame, to maintain shaft alignment throughout, is ensured by three precautions: First, the front end-frame is inclined and the rear end-frame is vertical. Second, heavy through-bolts, with spacers, join the side-frames between the swing-jaw and pitman. Third, the rear end-frame is made with a heavy rib projecting inwardly and securely bolted at its extremities to the side-frames. There is no possibility of the machine getting out of alignment. The inclination of the front end-frame, about the same as the swing-jaw, also ensures half of the weight of the stone being carried on the frame, increasing the sliding movement with less power. This equalizing the slope also has the advantage of allowing the machine to handle effectively a larger piece than would be possible in crushers of the same size that have one of the two jaws vertical.

The remaining parts of the machine are made in the same way that has for years been typical of Kennedy crushers. The spring-balanced pitman, water-jacketed in the large sizes; the efficient lubrication methods; the general rugged strength of the machine are all retained. The jaw-plates are made so that they may be used in either jaw and may be reversed end for end and side for side, an exclusive Kennedy feature, patented, providing twice the wear obtainable from any crusher jaw-plate not so designed.

POWER-TRANSFORMERS

The economical transmission and distribution of electrical energy has largely been made possible through the development of the power-transformer. As the demand for electric power increased, the feasibility of utilizing hitherto wasted water-power and also the economy in supplying power from a single central station became apparent. The location and requirements of the large industrial centres were such that in only a few sections of the country was it possible to take advantage of these economies. The perfection of the high-voltage power-transformer, however, made possible the economical transmission of power over long distances and its

distribution over large areas. There has been a steady increase in the size of power-transformers, and, with the growth of the large transmission systems, voltages which a few years ago were considered impracticable are now generally employed.

The Allis-Chalmers Manufacturing Co. has had no inconsiderable part in this development, having designed and built some of the first as well as a number of the large transformers for the highest transmission voltages used at the present time; it is prepared to build transformers of any capacity for any voltage that may be required. Allis-Chalmers transformers of all sizes are in service on many of the largest transmission and distributing systems of the country.

In general all oil-immersed transformers have the same general characteristics. That is, coils are so assembled that the oil can flow freely through all parts of the transformer, carrying away the heat and preventing hot spots. Natural circulation then carries the hot oil into contact with surfaces cooled either by water or by the outside air; or the oil may be carried by forced circulation to some outside point to be cooled in the same way. In Allis-Chalmers transformers the coils are circular, to give the greatest resistance to distortion on short circuit, and are usually pan-cake type, with short paths for flow of heat to the oil, which circulates through vertical ducts. This gives a good circulation in the oil, which flows upward past vertical coil surfaces. A thin light oil is used which flows readily and which at the same time has absolutely safe flash- and fire-temperatures. Single-phase transformers are shell-type. Therefore the coils are assembled on one leg and are placed centrally in a round tank. Thus no oblong tanks are used except for the three-phase transformers built with phases placed horizontally. Tanks used are of boiler-plate with welded seams and are either plain, jacketed, or arranged for bolting on radiators, as in the large self-cooled units.

LITIGATION OVER PATENTS

A suit has recently been brought by the Chicago Pneumatic Tool Co. in the United States District Court in the Western District of Michigan against the Keller Pneumatic Tool Co. for injunction and accounting of profits and damages due to the alleged infringement of certain United States patents by the manufacture and sale of the so-called Keller Master Super-Hammer. The patents involved are No. 879,106, 897,958, 1,029,082, and 1,126,069.

Suit has also been brought against the H. Channon Co. in the United States District Court at Chicago for infringement by the sale and offering for sale of the above-mentioned Keller hammers, and for unfair competition by acts calculated to produce confusion in the trade.

The above suits should not be confused with the one heretofore brought against the Keller Pneumatic Tool Co. in the United States District Court at Philadelphia for infringement of patents No. 730,887, 822,146, 866,573, and 917,242, which suit is being vigorously prosecuted.

Suit is also pending in the United States District Court at Chicago against the Keller Pneumatic Tool Co. for infringement by the use of the trade-name 'Keller', and certain other trademarks of the Chicago Pneumatic Tool Co. The company desires to warn the trade and public not to make, use, or sell tools or parts thereof which infringe the patents and trade-names that belong to them.

COMMERCIAL PARAGRAPHS

Bulletin No. 239, issued by the **W. S. Rockwell Co.**, relates to an improved type of forge-furnace built to meet the demand for equipment which will lower production costs. The novel features of the furnace consist of means for better application of the heat, protection of the operator, and utilization of waste gases to pre-heat air and fuel for combustion. The comparatively cool working end permits the close grouping of furnace and machine and a more efficient method of handling, resulting in greater output, better working conditions, and decreased cost of production.

The Pawling & Harnischfeger Co. has just issued a new bulletin on the P & H No. 6 radial wall-drill. This drill is designed to meet the demand for a simple and effective machine for drilling, reaming, and countersinking large unwieldy pieces, such as structural shapes and boiler-plates.

H. A. Kimber, formerly of the Quigley Furnace Specialties Co., L. W. Marso, O. M. Rau, formerly consulting engineer to the Philadelphia Rapid Transit Co., and W. O. Rankin have become associated with the **Hardinge Co.** since the pulverized-fuel department of the Quigley Furnace Specialties Co. has been acquired by the Hardinge Co.

A booklet entitled 'Flotation', which is a brief survey of this subject by H. J. Stander, is being distributed by the **Hercules Powder Co.** The book contains interesting information on the flotation processes and the various oils used. Mr. Stander, who is also the author of 'The Flotation Process', 'Interfacial Tension in Flotation', etc., is now flotation engineer with the Naval Stores Division of the Hercules Powder Co. The pamphlet is not of an advertising nature, but has been published simply to provide information to users of flotation oils. The functions of oil in flotation are summarized as follows: 1. Decreasing the surface-tension of the water with the result that a more permanent gas bubble is formed. 2. Forming a molecular oil-film around mineral particles in contrast to its action on silica and so producing a surface film that promotes the non-wetting property. 3. Increasing the force of cohesion between sulphides and so helping in the formation of a network of mineral particles. 4. Acting as an emulsifying agent, affecting the gas bubbles in such a manner that a decrease in size and an increase in number become apparent. Anyone interested may obtain a free copy of this booklet by writing to the Naval Stores Division, Hercules Powder Co., Wilmington, Delaware.

The development of the hydraulic turbine in the United States during the last fifteen years has been phenomenal. Prior to this period, American builders were unquestionably outranked by those in Europe. The hydraulic turbine, although built for many years in America, had been developed experimentally with little recourse to theory. European designers, on the contrary, had analyzed the theory of the turbine with great care, and, although somewhat lax in their experimental work, had acquired a decidedly superior knowledge of the art. About the year 1905, however, the development of water-power on a large scale in this country stimulated American turbine builders to a more progressive policy. Since that time the improvements in design has been remarkable; today the turbine builders of the United States lead the world. No other continent has developed its water-power on so large a scale as North America, and the turbines for these mammoth plants are of a size and refinement of design unparalleled in Europe or elsewhere. Thorough tests are made at Holyoke, Massachusetts, which at present is the only official testing flume in the United States; and they have been an important factor in the development of the American turbine to its present state of high efficiency. In this respect the **Wellman-Seaver-Morgan Co.** has been a leader. This company was first to obtain an efficiency of 90% at Holyoke (test No. 1799, efficiency 90.47%); likewise the company was first to obtain an efficiency of 92% (test No. 2497). Since that time runners have been developed to meet practically all ordinary conditions at an efficiency of 90% or over when tested in the Holyoke flume. Under favorable conditions and with vertical settings, results in the field show efficiencies as high as 93%.

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T. A. RICKARD, - - - - Editor

TO those who see only the surface of things, the appropriation at this particular time of $1,000,000 for building a concentrator to treat copper ore may not seem sagacious. Nevertheless, the directors of the Britannia Mining & Smelting Company have authorized the expenditure of that sum to build a 2500-ton flotation plant to replace the one destroyed by fire last February. By this action they display confidence in their mine and confidence in the market for copper. They need a new concentrator, and the sooner they build it the sooner can they resume production!

IN this issue we publish a timely article by Messrs. Girard B. Rosenblatt and Graham Bright on 'Electricity in the Development of the Mining Industry'. Both gentlemen are connected with the Westinghouse company, Mr. Rosenblatt being particularly well known throughout the Western States by reason of his position as engineer in the mining division of the industrial department of the Westinghouse organization. His contact with the problems of the mining industry is probably as intimate as that of any other electrical engineer in the country. Some believe mistakenly that there remains little opportunity for further marked progress in the application of electricity to the operation of mining and metallurgical plants; this paper draws attention to the directions in which advance may be expected. The owners of mines should not overlook the necessity for considering all factors in comparing the cost of work done by electrical machinery as against that done by hand or by power in other forms. The first cost of electrical equipment may be high, the unit-cost of electric power may seem excessive, but the comparison should be made on the final cost per unit of accomplishment. The greatest need of the mining industry today is efficient production; the intelligent use of electricity is a means toward that end.

SPEAKING of waste in industry, it is noted that the committee of engineers appointed by the Federated American Engineering Societies made no mention, in its report, of the appalling loss that is incurred because of lack of systematized publicity in the results of research work and technical operations. We stressed this point in a recent editorial on indexing current technical literature, and it has elicited several appreciative comments from readers. Strangely enough, however, no replies that were sent for publication came from librarians, but we were interested to see, in a recent issue of 'Chemical and Metallurgical Engineering', that Mr. K. C. Walker, the Research Reference Assistant at the Bureau of Mines Experiment Station at Pittsburgh, makes a strong appeal for the special technical library. Andrew Carnegie is quoted as saying that his organization wasted a great deal of money because it failed to find out what others had done before research and experimentation were commenced. A considerable number of the larger industrial organizations in the United States maintain efficient staffs to abstract and to index material that may be of interest or of value to their technologists. In one case, in which about 200 publications are examined, the value of such a department has been proved by a striking increase in the number of inquiries; it is estimated that 32 large commercial firms in the country publish abstract bulletins for the use of their own employees, but small concerns are unable to meet such an expense. A centralized and co-operative effort is desirable, particularly in regard to progress in the mining and metallurgical industries. The waste that occurs as a result of inefficient indexing, of faulty systematizing, and of misguided publicity-efforts may be the natural sequel to an effort to eliminate a fault rather than to prevent its occurrence.

FLOUR GOLD in sea-water is something new. "As you are aware," writes an enterprising individual, "there is gold in the ocean to the amount of 60 cents to every cubic yard . . . The waves of the sea have been throwing up the Flour Gold on the sea shore for ages and ages, till the ground is saturated with it. We have had tests made of the mud and sands along the shore on the Oakland side [of San Francisco bay] and got the same uniform result: $16, $25, and up to $50 per cubic yard. We have started to build a machine that will save this gold, and, owing to the ruinous prices of the machinists of Oakland we have run out of money to finish it." Then comes a harrowing description of past difficulties, of the knavery of a lawyer, of the announcement that the patent papers are on file in Washington, and the intimation that efforts are being made to build the machine "so as to recover the flour gold of which there is more than any other kind of gold". Fresh bait is used afterward to tempt the would-be investor, who learns that the gold

"is washing into the ocean in all parts of the whole world, millions and billions of dollars of it every year". The scheme evidently relies on perpetual motion; for the immense quantity of flour gold that it is the inventor's mission in life to recover is, apparently, washing into the ocean and, simultaneously, being thrown up on the seashore, particularly near Oakland. We believe there is gold in sea-water, but we are sceptical as to the results expected by the use of a machine that, it is claimed, "will save the Flour Gold in the earth, as well as in the waters of the Ocean". To this we may add that the idea of winning gold from the sea originated as early as 1872, when E. Sonstadt, in the 'Chemical News', mentioned qualitative experiments that he had made and stated that the amount of gold was "certainly *less* than one grain in the ton". He has been misquoted repeatedly as having said that there was "one grain per ton". As we have said more than once, there is gold in the sea and silver in the moonbeams.

THE residue of today may be a source of supply for tomorrow. Values are of relative significance. A mine that was considered unpayable 50 years ago might be termed a bonanza at the present time; and so it is that discarded residue, which contained so little metal when dumped that the engineers in charge of operations congratulated themselves, often becomes an asset for succeeding generations. The value of an accumulation of such material depends to a great extent on the scheme of treatment adopted by the pioneers. The concentration of gold that is disseminated throughout sand is more feasible than the concentration of gold that is associated with slime. The removal of the valueless or the isolation of the valuable is the basis of all metallurgic processes, so it is evident that the avoidance of sliming will ensure the possibility if not the probability of additional treatment and additional profit. Immense dumps of sand have accumulated on the Witwatersrand goldfield, after many years of operation by an amalgamation-cyanidation process. The average assay-value of the material is exceedingly low, probably under 40 cents per ton, so that a repetition of hydro-metallurgical methods for the further extraction of the gold from the unconcentrated residue may be considered impracticable; but if a cheap method of separation be employed, it is possible that the amount of material to be treated by actual extraction methods of amalgamation or cyanidation, or both, may be reduced considerably, and the cost of such treatment should be diminished proportionately. Many schemes have been proposed, and we note that an attempt is to be made in the near future to treat the tailing that has accumulated from the leaching of the ore from the May Consolidated mine, at Johannesburg. From the scanty information available it would appear that the material is to be pulped with water and subjected to treatment in a special type of hydraulic classifier. The underflow from this is to be passed over tables of the Wilfley type, yielding concentrate, middling, and tailing, the last-mentioned being returned to join the overflow from the reject of the hydraulic classifiers. It is hinted that amalgamation will be adopted to recover the gold from the concentrate, whereas the middling will be re-ground in tube-mills and, possibly, re-concentrated. The results of the work will be watched with interest by those who are anxious for a revival in gold mining, especially if they have at hand residues from a leaching process.

CONCENTRATION involves the segregation of waste and the isolation of the more valuable constituents of the ore. The selective treatment usually begins in the mine; later, it often forms a preliminary to metallurgical treatment in the mill and cyanide plant. In this issue Mr. C. Flury describes an interesting innovation at a plant in Korea, at which, after the number of stamps in the battery had been increased, it was decided to avoid the overloading of the hydro-metallurgical equipment, the capacity of which was not increased, by concentrating the crushed and milled ore and by discarding some of the waste. A few comments on Mr. Flury's figures are pertinent. Concentration usually involves a loss of the metal that is being sought, and must be taken into account. We do not know the amount of such loss in this particular case; we presume that it was insignificant; under such conditions the procedure of concentration prior to cyanidation is a sensible one. A second point is that, if a high-grade product can be secured, it is advisable on account of the small tonnage to consider the possibility of obtaining a maximum extraction of precious metal. Comparisons of extractions are misleading unless the grade of the material treated be taken into account. If the concentrate be rich in gold that is encased in pyrite, as it often is, sliming and amalgamation are indicated as a suitable preliminary combination treatment, for by such means it is usually possible to ensure low ultimate residual loss. The cyanidation of an amalgamation tailing is invariably highly successful. A fair extraction can be obtained sometimes from high-grade material by the adoption of a leaching process, but it usually involves an abnormal loss of chemicals because of the protracted time of treatment. In Mr. Flury's case the problem is complicated by the presence of graphite in the ore; this is removed with the slime during concentration, thus obviating the danger of re-precipitation of gold during cyanide treatment. An interesting application of this idea of concentration prior to cyanidation is being made in South Africa, where it is proposed that, instead of cyaniding the whole of the sorted ore, the latter after crushing and milling would be subjected to oil-flotation, whereby it is claimed that the amount of material to be treated subsequently by amalgamation and cyanidation may be reduced to one-tenth, the concentrated portion carrying 95% of the gold in the ore. As we pointed out in a recent issue, there is little hope for further improvement on the Witwatersrand by the introduction of a process that aims to increase extraction or to decrease costs per ton if cyanidation or amalgamation, or both, be used. Nevertheless, if the tonnage can be reduced appreciably before wet-

chemical treatment is commenced, it is evident that a field exists for the introduction of efficient concentration apparatus and methods; there is also justification for the adoption of more expensive methods of all-sliming in conjunction with amalgamation, and as a preliminary to cyanidation and the ultimate treatment of the finely-ground pulp on a vacuum- or pressure-filter. Further developments will be watched with interest; in the meantime, Mr. Flury's experiences may well form the basis of further discussion from interested metallurgists.

Concentrating Magnetite Ore

The first unit of a plant that is expected to prove definitely the success of the proposed scheme for concentrating the low-grade magnetite ore of Minnesota is almost completed. For years the Mesabi Range north of Duluth has been the source of 'high-grade' hematite ore containing 55% iron. Of this there remains, according to various estimates, between 1½ and 3½ billion tons; in addition, there is known to exist, in the eastern portion of the range, something like 30 billion tons of material containing magnetite and averaging about 25% iron, that until recently did not even aspire to be 'ore'. Seven years ago Mr. Edward W. Davis, then an instructor in mechanical engineering at the School of Mines of the University of Minnesota, devised, after many experiments, a crude contrivance for the separation of the iron minerals from the worthless portion of this low-grade magnetite ore. In 1915 Mr. W. G. Swart, of Denver, made a visit, first to the iron ranges east of Mesabi, and then to the University at Minneapolis, where he carefully inspected Mr. Davis' machine and listened to his explanation of its operation. The result of this examination was a telegram to Mr. D. C. Jackling, whom Mr. Swart represented, saying: "The whole enterprise of the eastern Mesabi warrants further investigation". The next step was the erection of an experimental plant at Duluth; here Mr. Swart, with the assistance of Mr. Davis, spent three years in improving the machine and satisfying himself that the low-grade ore could be made to yield its magnetite. During the period of the War the plant successfully treated 25% ore, making a concentrate analyzing 65% iron, which, when sintered, formed a most desirable feed for iron blast-furnaces. Mr. Davis, who since 1919 has been superintendent of the Minnesota School of Mines Experiment Station, describes the device, upon which rests the success of the entire project, in these words: "The wet-magnetic separator is similar to the ordinary log-washer in construction, with the exception that to the bottom of the trough is attached a series of magnets. These magnets hold the finely ground magnetite to the bottom of the trough, where the action of the logs forces it up a slope and delivers it as a clean concentrate, while the non-magnetic material is kept in agitation and is washed over the rear end of the machine as tailing. The machine is simple and economical in operation, and the wear on the logs is much less than in ordinary log-washers, owing to the fineness of the particles of ore that are treated, all of it having been finely ground before going into the machine". The operation of the experimental plant at Duluth had proved conclusively that the machine could make the required separation; it had supplied data on which to base an estimate of the cost of operations on a large scale. This estimate and the others made by Mr. Swart and his assistants were sufficiently satisfactory to warrant the next step in the program of exploiting these low-grade ores. Mr. Swart went north to a station having the euphonious name of Sulphur Siding, and there built an industrial town, which he christened Babbitt; here 375 workmen and their families have made their home, and here during the last two years $4,000,000 has been spent in erecting and equipping the first unit of the concentrator; in providing the necessary shops, power-plant, and other adjuncts; and in preparing for steam-shovel mining operations. The preliminary work is almost completed; within a few months productive operations will commence, and shortly thereafter the question 'How cheaply can a concentrate analyzing 60% iron be obtained?' will be answered. Will the enterprise be an economic as well as a technical success? Mr. Jackling and his engineers have endeavored to foresee every unfavorable contingency; they have checked and re-checked their calculations and they are convinced that they are right, or they would not have invested $5,000,000. But even the best of engineers is not infallible. Mr. Jackling spent many millions in an effort to win a profit from the low-grade gold ore of Juneau, in Alaska, but he failed because he erred in estimating one factor of the many involved in his calculations. He mined the 'rock' for less than he had expected; he milled it for less than he had hoped; but each ton contained less gold than he had anticipated—this was 'the nigger in the woodpile'. In the eastern Mesabi project the existence of adequate deposits of ore having the required iron content has been proved as conclusively as is reasonably possible; it is an easier task than sampling the goldbearing rock at Juneau. The ore will be mined by steam-shovels and there is little room for error in estimating the cost. One consideration is the fact that, on account of the weather, open-cut mining can be conducted during only six months of the year; this will be overcome by storing the winter's supply of ore in stock-piles near the mill. In anticipation of the ultimate exhaustion of the high-grade iron ores of the United States the big steel companies have already acquired iron-ore deposits in Spain and Sweden, in Cuba and Brazil, and in China; they can afford to transport ore by boat and to smelt it on the coast in this country, but to transfer it and carry it to the furnaces situated inland is costly. On the other hand, the sintered concentrate enjoys the advantage of cheaper transportation to inland steel plants; as a material for furnaces it is ideal, so that a market seems assured. The one uncertain factor in the project is the cost of treating the ore. It is to be crushed in stages, first through a special heavy jaw-crusher to 12-inch size, then through another jaw-crusher to 5-inch, through gyratories to 2-inch, and in rolls to ⅜-inch. This product will pass through a 'drum cobber'—a belt-conveyor with a magnetized head-pulley

—by means of which half of the crushed material will be discarded. The remainder will be crushed wet in ball-mills to 100-mesh, after which it will pass through the machine devised by Mr. Davis. Coke-breeze, anthracite-dust, or other cheap fuel will be added to the concentrate *before* dewatering, and the mixture will be partly dried on vacuum-drum filters. The cake will be sintered or nodulized before shipment to the blast-furnaces. The narrow margin of profit that is anticipated when the entire plant is in operation is indicated by the fact that the present $4,000,000 unit is not expected to earn more than enough to cover the cost of operation; a plant of 22 units with a combined daily capacity of 75,000 tons of ore, rendering possible a wider distribution of the overhead cost, will be required to make the venture profitable. Steel is the backbone of industry and it is inevitable that the deposits of the eastern Mesabi should be utilized eventually. Let us hope that the time has arrived.

The Washington Conference

The Conference at Washington continues to occupy the centre of the stage in world affairs, and it is well that it should do so; for the matters that are being considered by the leaders of the nations at our Federal capital are of paramount consequence to humanity. So far the deliberations seem to have progressed satisfactorily. The proposal, made by the United States, for a reduction of navies has been received favorably; and the adjustment of relations between China and the powers interested in the exploitation of that country is making progress. Any attempt to arrive at an international agreement for the reduction of armies has been checked for the moment by the oratorical gesture of the French Premier, and his insistence upon the danger to which his country is subject from German aggression; but it is still to be hoped that such assurances of protection for France may be forthcoming as will justify M. Briand and his fellow delegates in diminishing their military establishment. For the rest, the Conference is providing instruction to all of us; the public discussion of great questions by competent men is educating us in matters of vital concern to the welfare of civilization; the exchange of ideas, even if it provoke an occasional clash, helps to promote mutual understanding between the representatives of the nations on whom at this period of history rests the direction of world affairs. Our own representatives have done credit to themselves and to the United States; Secretary Hughes has demonstrated statesmanship of a high order; and there is reason to believe that his colleagues have shown similar sagacity in committee. Much is being written about the Conference in the daily press, and it is sad to see how much of it is of a petty kind. From Mr. Bryan to Mr. Bill Jones the correspondents think it clever to impute sinister motives and to intimate a knowledge of intrigues that are largely of their own invention. The worst exhibition is that of Brisbane, whose articles in the Hearst press exhibit a malignity and ignorance worthy of a vicious schoolboy. It is pitiful to think that many thousands read his piffle as gospel and have no means of correcting the misinformation with which he fills them. Mr. David Lawrence and Mr. Louis Seibold are among the few gentlemen of the press that appear able to maintain a sane mental poise and endeavor to treat the doings of the Conference with intelligence and philosophic discrimination. They are upholding the best traditions of their craft. This is a time when the press is under heavy responsibility, for upon it rests the duty of furthering the great purpose of the Conference by just comment and the honest transmission of news. To mislead or to misinform at this juncture is a crime against humanity. The issue is too great to excuse levity and too momentous to pardon pettiness of mind. As Mr. Lloyd George has said: "The American Conference has the future of civilization in its charge; it is the greatest event the world has seen in 1900 years". We are proud to have it named the "American" conference, for it was planned by the President and is being led by the Secretary of State. Even if it fail in creating a millenium, it is destined, we believe, to mark the beginning of a new era in world affairs. Although we cannot go as far as Mr. George Harvey in believing that "the night of concealment, deception and intrigue has passed, and the day of openness, frankness, and sincerity has dawned", we do believe that the Conference will demonstrate the need for open discussion of international difficulties, and will induce the governments of the world to appreciate the fact that wars, like labor strikes, can be obviated by means of discussion and delay, by the ventilation of conflicting ideas and the public presentation of the points at issue. The peoples of the earth insist that wars shall not be foisted upon them by the hole-in-the-corner decisions of a military clique or a group of unscrupulous diplomats playing men as if they were mere pawns on the board of destiny. It is certain that if the Serbian question could have been discussed frankly at a conference of the powers and if the facts of the case could have been made public in the summer of 1914, it would have saved the world from the horror of four years of slaughter and devastation; if England had been in a position to state frankly that she would resent by force the invasion of Belgium and if France had made it known that she would fight on the side of Russia, it is extremely unlikely that the Kaiser and his followers would have dared to embroil the world. Another "if": if the United States had known, as we know now, that a world war such as that of 1914-1918 would involve her inevitably, she also would have had something to say. Whether it be a League of Nations or an Association such as the President advocates now, it is certain that there is needed an organization, a deliberative assembly, for the public discussion of international questions. A frank talk has prevented many a fight. Most fighting is caused by misunderstanding either of motives or of consequences. The Conference is a rainbow across a sky from which a bloody rain has but lately fallen upon the homes of men. We cherish the hope that is symbolized by the rainbow, and urge our readers to do what they can, in private and in public, to uphold the hands of our representatives at Washington.

Concentration and Cyanidation

The Editor:

Sir—The extension of our mill from 30 to 50 stamps necessitated the installation of concentrating equipment, as the leaching-plant became too small; it was decided to concentrate the sand, after a preliminary classification of the pulp into sand and slime, by means of 10 Wilfley tables, one to each battery. Little time could be spared for preliminary research, and anxiety was expressed as to whether the extraction would remain as before, or become better or worse. It was expected in some quarters that an increase would occur, because the reduction in tonnage would allow a longer time for cyanidation treatment and an increased number of transfers.

Formerly, by direct treatment, the process was applied as follows: To 60 metric tons of sand, mixed with 150 kilogrammes of lime, 8 tons of working solution was pumped. This solution contained 1.8 kg. KCN and 1.4 kg. CaO per ton; it was strengthened with 25 kg. of cyanide at first, which was added as a solid to the charge during pumping, bringing the working strength up to 4 kg. KCN per ton. This strong solution was left in contact with the sand for a period of eight hours. After percolation, the ordinary working solution was applied. Every four days the sand was removed into another vat and finally discharged to the tailing dump. After 12 days total treatment the extraction averaged 80%.

In order to be on the safe side we commenced with the low concentration of 1 to 2. To treat the concentrate with cyanide, the same method was adopted as for ordinary sand, but the time of treatment was extended to 16 days, and instead of transferring twice we removed the concentrate three times. Extraction was as follows: First treatment, 71.1%; second, 74.7%; third, 83.1%; fourth, 86.5%. It seems improbable that an extraction of only 3.6% should be obtained by the second treatment, 8.4% by the third treatment, and only 3.4% by the ultimate treatment. Nevertheless, the actual extraction, indicated by the clean-up, was 86.5%, thus showing an increase in extraction of 6.5%, as compared with direct treatment of sand.

During the second month, under the same conditions in regard to concentration, the extraction was as follows: First treatment, 60%; second, 76.8%; third, 83.3%; fourth, 86.5%. The final extraction was the same as in the preceding month. It is interesting to note that the extraction during the first stages of treatment is 10% higher than is the case when sand is being treated. This must be attributed to the preliminary concentration. With concentrate of varying grade, the higher-grade material gave, as a rule, the better extraction. For instance, concentrate of an assay-value of $20.50 gave tailing, $2.65 and extraction, 87.6%; concentrate with an assay-value of $15.25 gave tailing, $2.65, and extraction, 83.5%. With a concentration of 1 to 3 the extraction was as follows: First treatment, 66%; second, 76.5%; third, 81%; fourth, 85%; fifth, 87.5%. I therefore raised the concentration ratio to 1 to 4, as there was still an opening for improvement, and obtained the following results: First treatment, 73%; second, 80.4%; third, 85.5%; fourth, 87.5%; fifth, 88.7%; sixth, 90.2%. The actual extraction amounted to 93%. The higher the concentrate was in value the higher became the extraction. The higher the ratio of concentration the longer became the period of treatment and the more numerous the transfers. When the concentration was 1 to 4, the concentrate remained 25 days under treatment and was removed five times, whereas the ordinary sand was submitted only to 12 days treatment and one transfer. By comparing the treatment of the concentrate with that of the ordinary sand, after each had received an equal time of treatment and the same number of transfers, the results were as follows: Extraction from concentrate, 85.5%; extraction from sand, 80%. The improvement must be credited to concentration. The difference between the maximum extraction in each case, 90.2% and 85.5%, must be attributed to the greater number of transfers and to prolonged treatment.

The improvement in extraction owing to concentration must be due to physical change. The concentrate is cleaner than the original sand, the latter being enveloped in a skin of clay, which I have failed to observe on the concentrate. Such a film is removed by the cleaning action of the water and the shaking movement of the tables. Besides, our ore carries a considerable amount of graphite, which is eliminated by the tables, being washed away in the tailing. In addition to the circumstance that the concentrate is cleaner than the sand, the solution is in more intimate contact, and the elimination of soluble salts on the table-deck results in a considerable saving of zinc, cyanide, and lime. It is impossible to state how much this saving is. The question is complicated; economies are caused by the reduction in tonnage; an increased consumption of chemicals is due to the concentration of the metal in the concentrate; this, however, is not so high as was expected, because the water film on the table-decks removes a great deal of worthless and chemical-consuming material.

When the alkalinity is held at the same amount for the treatment of the concentrate as for the sand, the amount of precipitate increases almost in the exact pro-

portion as the ratio of concentration. For the same amount of gold recovered we had about three times as much precipitate from the 1:3 concentrate as we would have obtained by treating the ordinary sand direct. I decreased the alkalinity to as low as 0.7 kg. CaO per ton of solution. The precipitation remained excellent, showing only traces of gold in the sump, but the amount of precipitate became normal, containing as much as 40% gold and silver, so that cupellation was not warranted. A saving of one-half of the zinc and lime was also effected.

The increased extraction in the leaching-plant when the sand is concentrated before treatment is not due to the increase in the capacity of the plant, which allows longer treatment and more frequent transfers; it must be credited to a large extent to a favorable physical change in the material during the passage over the concentrating tables. To the same cause must be attributed economies of chemicals, which cannot be accounted for by the reduction of tonnage.

C. FLURY.

Taiyudong, Korea, October 22.

Wetting and Amalgamation

The Editor:

Sir—In your issue of November 12, Mr. Samuel H. Dolbear asks for opinions on the view of one of the Examiners of the U. S. Patent Office, namely, "That the selective preference of quicksilver for gold is analagous to the selective preference of oil for metalliferous substances". Mr. Dolbear himself holds opposite views on the subject.

Except that I think "metalliferous substances" is rather too vague and too broad an expression, I am disposed to agree with the Examiner. That mercury possesses the property of 'wetting' gold, while it will not 'wet' the other constituents of ordinary gold ores, seems to me to be its great value as a medium for concentrating the precious metal. The fact that afterward the gold absorbs mercury and forms a series of amalgams of definite and indefinite composition undoubtedly plays a part in the concentration of the gold, in that it cements the particles of gold together and to amalgamated copper, and thus better retains them in the riffles of sluice-boxes and on the plates of stamp-batteries; but, in my opinion, this is altogether a secondary part, and in itself would be quite useless.

When a particle of gold is first ejected from the mortar-box of a stamp-mill onto the outside copper plate it may readily be moved about from one part of the plate to another by pushing it with a finger, but it is not easy to detach it from the plate, is being securely held there by what Professor Vernon Boys in his delightful little book, 'Soap Bubbles and the Forces that Govern Them', calls the elastic surface-skin of liquids, the liquid in this case being mercury. The gold at once begins to absorb mercury, and, in the event of a fairly 'dry' plate being used, ultimately becomes firmly cemented to the amalgamated surface of the copper plate.

One may readily demonstrate the selective property of mercury for 'wetting' and concentrating gold by mixing a few particles of clean gold with some particles of quartz on a large laboratory watch-glass, adding a globule of mercury, and rolling it about by gently rocking the watch-glass. The mercury will readily 'wet' the particles of gold, pick them up, retain them within the 'elastic surface-skin' of the globule, and carry them away from the particles of quartz; that is, if the gold particles are not too heavy. Here, and here only, in my opinion, lies the analogy between the two processes, although I do not know that it has been definitely demonstrated that the oil used in flotation does not sometimes penetrate beyond the surface of the particles of sulphides and that in some instances a certain amount of chemical combination does not take place between the oil and the sulphides.

If I understand him rightly, I disagree with Mr. Dolbear when he says: "Gold amalgam in an excess of quicksilver is either a true solution as an alloy dissolved in quicksilver, as gold in a true solution, or it is an alloy of variable chemical structure, according to the amount of quicksilver available for the structure". Some 25 years ago I made some experiments to discover how much gold mercury was able to dissolve at ordinary temperatures, and the conclusion I reached was that the affinity between the two metals was exhibited more by the precious for the base than the base for the precious metal. In order that the gold might be in a fine state of division, so that the mercury might have every opportunity of dissolving it, it was added to the mercury in the form of a slightly acid solution of the chloride. The gold was readily precipitated from solution by the mercury, of course, and at once amalgamated with it. To give the gold every opportunity of going into solution the mixture was kept at a temperature of 100°C. for several days, it being well known that gold is more soluble in hot than in cold mercury. I closed the end of a piece of half-inch glass tube, about 30 inches long, and drew out a series of horns, about four inches apart, on one side of the tube. This was supported in a burette stand, the mercury and amalgam, while still hot, being poured into it, and allowed to stand for several days, so that solids might have every opportunity to settle. Commencing at the top one, the points of the several horns were nicked by a file, and broken off, thus allowing the mercury above them to flow out of the tube. Each section was collected separately, and assayed for gold. I have not the details at hand, but I remember that the mercury in the upper sections of the tube contained on an average 0.125% of gold. The mercury in the last two sections above the bottom one contained slightly more gold, which I concluded was due to a small amount of amalgam in suspension. This clearly demonstrated, I think, that under the most favorable conditions mercury will not hold in solution more than one-eighth of 1% of gold at normal temperatures, say, about 18°C. The amalgam in the bottom of the tube was transferred to a dish, and the surplus mercury was drained off. The amalgam was then plunged into a porcelain dish containing boiling nitric acid. When all action had ceased

the mercuric nitrate was poured off, the residue being washed first with hot dilute nitric acid and then with hot water; then dried, and annealed in the dish in a muffle. The gold thus obtained was in the form of the most gorgeously beautiful mass of cubic crystals and skeletons of crystals. It was on view in my laboratory, at Halifax, for many years, and was much admired by visitors. The skeleton-crystals would seem to indicate that a definite alloy of gold and mercury had been formed.

F. H. Mason.

Victoria, B. C., November 15.

Revision of the Mining Law

The Editor:

Sir—Mr. Albion S. Howe, in his contribution on this subject in your issue of November 16, wants to know "if the gentlemen who framed these proposed laws had ever hunted any section corners in remote places". Permit me to reply that one of them did, and that for three years a large portion of his income was derived from the hunting of section and quarter corners, re-establishing them when they were lost, and dividing sections; and he is quite well aware of the difficulties attending this work.

In the law as proposed by the Bureau of Mines it is not vital that the claims be laid out on cardinal lines, or that they conform with the subdivisions of the Public Survey. It simply was meant that the committee thought that these provisions were desirable. If the general feeling is that they are not, the real spirit of the proposed law will not be affected by changing it. Incidentally, it is interesting to note that a great many criticisms of the proposed law are made by people who evidently have not read the law in its entirety, nor have they read the present mining law and they do not know that a great many of the things to which they object are actually in the present law.

J. Parke Channing.

New York, November 21.

The Use of Scrapers Underground

The Editor:

Sir—I have read with much interest the able article on 'The Use of Scrapers Underground', by Mr. Lucien Eaton, in your issue of November 19. I have been interested in this subject for some time and would call attention to the fact that scrapers have been used successfully for several years in the coal mines, notably those of the Hudson Coal Co., operating in the Anthracite region, near Scranton, Pennsylvania. The system there used and known as the Evans Scraper Loading System, is well illustrated in Bulletin No. 1, Engineering Development Co. of America, Scranton, Pennsylvania, and was described in detail by H. D. Kyner of the Hudson Coal Co. in his able paper presented at the Wilkes-Barre meeting of the American Institute of Mining and Metallurgical Engineers in September of this year. This system has been used successfully in delivering coal to the haulage-way from 'rooms' up to 400 ft. in length. One hoist and scraper outfit is commonly used to serve four rooms, the hoist being set on the gangway in a position centrally located between the rooms. I have seen this apparatus working in a flat vein averaging only 20 in. thick, all hand-shoveling being eliminated. In the operations to which I refer, the difficulty in dragging the scraper around right-angled turns, which was mentioned by Mr. Eaton, has been successfully overcome by the use of an open-frame snatch-block from which the rope is thrown after the scraper has reached the point of turn, and a vertical drum or buffer which guides the scraper around the turn. For a more complete description I would refer those interested to the bulletin and paper above mentioned, and would recommend the investigation of this system to metal-mining engineers interested in the use of scrapers for underground work.

In my earlier experience in the Western metal mines and later experience in the coal mines, I have often remarked the lack of interchange of ideas between engineers engaged in metal mining and those engaged in coal mining. I believe that such interchange of ideas might often prove of mutual benefit, though I realize that in many particulars the problems involved are very different.

Cleveland, November 21. C. F. Jackson.

Errors Latent in Mine Sampling

The Editor:

Sir—I have read Mr. Morton Webber's article, in your issue of November 5, with a great deal of interest, particularly the latter part relating to the Aurora Consolidated, with which property I am familiar in a general way. My reason for dropping you these few lines is to call attention to the similarity between the conditions at the Aurora Consolidated property and the Bodie mines, of which I was manager a number of years ago. At Bodie we had the small cross-veins in a great many of the orebodies. You will recollect that attention was first called to them by R. Gilman Brown some time in the latter 'nineties. My experience at Bodie stood me in good stead when I again encountered the same condition in Nicaragua. Possibly you recollect my article, published in November 1912, relative to the mines of the Chontales district of Nicaragua. At that time I called attention to the cross-veins which Mr. Webber terms "willow" veins. In operating properties in Nicaragua I noted cross-cuts driven at irregular intervals. They are not all at right angles to the vein, however; in fact, previous profitable operations by the old-timers in that district were based entirely on following these cross-veins and what success I attained in the district during my four years stay was entirely due to following these cross-veins, which contained ore far richer than that in the general average of the main vein. A complete sampling of the Esmeralda mine by the Arroya-Babalonia interests showed an average of about $5, whereas my records during the time that I operated the property showed an average close to $10 per ton. The difference

is entirely due to the fact that all the ore that was extracted during my operation of this property was taken out along the one wall and along cross or willow veins.

As a result of my experience with properties of this type, in which the distribution of the gold is so irregular, I would suggest that on a deposit of this class shell-sampling, that is, a complete shelling of the roof by means of pop shots, is the only practical manner of getting at the average value of the ore, particularly as most of the metal in these willow veins is usually in the form of coarse gold, which in any method of groove sampling, particularly where the values are at right angles to the vein, and naturally tend to follow grooves, are apt to give one an error in sampling, with serious consequence, although I hardly see where a dirty roof should mislead any engineer who has had experience in previous sampling of mines of any magnitude. In fact, one of the first requisites of sampling, in my estimation, particularly on a gold property, is a thorough cleansing of the roof either by means of a wire-brush or brooms, using water with which to remove the finer accumulation that always is found in old mines.

New York, November 9. ARTHUR FEUST.

Technical Writing

The Editor:

Sir—The correspondent in your issue of November 5 who criticizes the letter of Mr. Paul R. Cook (in your issue of October 29) must have been in a bad temper. Perhaps that is the reason he signed as an anonymous 'Engineer-Journalist'. He begins by saying that Mr. Cook tires the reader by his verbosity, and then he writes a letter 50% longer on the same subject. Mr. Cook had made what seemed to me an excellent argument in a single column; the anonymous one splits hairs over it for a column and a half.

The principal point at issue seems to be: What type of article best suits the average reader of the mining-engineering weeklies? Mr. Cook suggests that condensed one-page articles are best, because the expanded (and sometimes padded) eight-page effusions are generally too long to read. The authors of these long articles are likely to be more intent on the prestige that a long article gives them than on condensing their observations for the benefit of the reader. This does not apply to the occasional long article of so interesting a writer as yourself, but to the average contribution. The protest of Mr. Cook seems to me well taken. Long articles seldom are read; short articles are. Then comes in your anonymous 'Engineer-Journalist' and drags his red herring across the trail. The practical man, he says, writes longer articles than the skilled journalists that produce the eight-page articles. The practical man is rather an ignoramus anyway, and never has learned to write; he can not criticize the article of a skilled journalist, nor can he think clearly and express himself succinctly. Obviously the anonymous one has a poor opinion of the practical man, and a high opinion of the skilled journalist. Of course, if the eight pages of the long article are full of meaty interesting material, it is not too long. Usually, however, it is meaty and interesting only in spots, like the curate's egg at the bishop's table. Possibly a long article interesting only in spots would attract more readers if changed into three or four short articles, each written around an interesting idea. The long transitions could then be omitted, and much routine or obvious material condensed considerably. More thinking by the writer of the article would be necessary, and the pages of the periodical would not be filled so readily, but the readers would gain, I believe.

P. B. MCDONALD.

New York University, November 11.

Sundry Observations

The Editor:

Sir—Mining engineers would hardly expect to find one of the best private collections of specimens in a candy store, but such is the case in New York. The hobby of M. L. Morgenthau, president of the Mirror Candy Co., a well-known concern, is the collecting of specimens, and in the rear of the firm's store on Broadway, near 43rd street, is a splendidly arranged display of hundreds of metals and minerals, in the rough and polished, worth many thousands of dollars.

Chains should receive attention just as hemp or wire ropes do, that is, they should be put away carefully when not in use. A friend connected with accident insurance recently informed me that in lifting a girder, a chain sling broke, killing a man, and the contractor using the chain had to pay compensation. It was proved that the chain had become crystallized, therefore the contractor was using faulty equipment. It is argued that the more a chain is worked the better its physical condition, but if used today and then thrown down anywhere, exposed to the weather, for weeks perhaps, the metal is likely to change in structure and become weaker. Large chains may be tested for ductility or brittleness by a magnetic system, similar to that for testing steel rails.

The tests conducted by the U. S. Bureau of Mines, in connection with ventilating the Hudson River Tunnel, are finished. I witnessed the last run, and found it extremely interesting. A motion picture was taken of a test and all apparatus, and will be added to the Bureau's library of films for distribution throughout the country.

During a visit to an open-hearth furnace plant and steel-rolling mill I noted the 'upward' pouring of 3-ton ingots, and wondered if at any stage in the melting of copper, lead, and zinc, or other metals at smelters or refineries this method would be of any use. Of course, the idea in pouring steel this way is to prevent shrinkage and 'piping' in the ingot. A number of molds stand over holes in the top of a hollow base-plate into which the steel is poured from the bottom of the ladle, and the metal rises quietly from the bottom of the mold until full.

M. W. VON BERNEWITZ.

Pittsburgh, Pennsylvania, November 17.

The Design of Flotation Plants

By Arthur B. Parsons

INTRODUCTION. It is safe to say that nothing else can convey, in convenient and intelligible form, as much general information regarding a concentrating plant as a flow-sheet; with this idea in mind I have prepared the eight flow-sheets reproduced in this article. Each represents the scheme of treatment that is being, or will be, used in a plant designed recently. The Nevada Consolidated flow-sheet is that of Section 4, which was completed just prior to the shutting-down of the plant at McGill, early in April. The other sections will be remodeled to conform in essential features to No. 4. The Copper Queen, Utah Consolidated, and Simon Silver-Lead mills have been completed within the last few months and are ready to operate. The starting of the first two will necessarily await the revival of the copper market, while the Simon company is waiting for the completion of the transmission line that will bring electric power from Hawthorne to its property. The Cerro Gordo plant has been in operation for a few months; the Boston & Montana plant is almost ready to run; and construction work by the California Rand company should be completed in December.

The reader will note that the plants in the accompanying tabulation are situated in six different States; that there is no connection whatever between the various companies; and that no two of the plants were designed by the same man or by the same organization. Moreover, the capacities vary over a wide range, and all of the metals that are commonly recovered by flotation concentration are represented in the list. No attempt has been made to show in the table all of the interesting facts, but rather to indicate some of the significant features in the choice of methods and machines. The comment that I make is based, not alone upon facts revealed in an analysis of these few plants, but also upon information gained from discussions with sundry well-known metallurgists. Naturally, no detailed discussion of the merits of different methods or machines can be undertaken in a single short article. My object, primarily, is to indicate tendencies in the design of plants and in the selection of equipment.

GENERAL FEATURES. Among the outstanding developments of a general character in mill-design are (1) simplification of the scheme of treatment and an accompanying compactness of the plant; (2) the use of reinforced concrete in places where wood and steel generally have been used; (3) the more efficient use of electric power, especially by means of individual motors for single machines, and improved devices for controlling motors; and (4) the tendency to choose the machine or equipment that is as nearly fool-proof as possible and that can be relied upon to perform efficiently with the minimum of lost time; continuity of operation is recognized as vital to the attainment of low cost.

One obvious reason for the small area occupied by a modern plant, as compared with the old type of concentrator, is the utilization of froth-flotation, but improvements in the details of modern design have been an important factor. For example, the fine-crushing department of the Utah Consolidated mill, which was designed and built by the General Engineering Co., of Salt Lake City, covers an area of only 101 by 62 ft., the overall length of the entire plant is only 260 ft., and a large portion of it is only 30 ft. wide. This is small for a concentrator having a daily capacity of 1000 tons. All the machinery in the fine-crushing department, with the single exception of the classifiers, is driven by individual motors, through either chain-drives or Lenix drives. The classifier-drives are so arranged that traveling cranes have clear passage in every direction. This calls attention to an important factor in permitting economy of space, and, incidentally, the efficiency and continuity of operation, namely, the increased use of overhead cranes, by means of which large machines can be removed bodily and replaced by others when repairs are necessary. The wide application of cylindrical mills has stimulated progress in this direction. In a plant of large capacity a spare ball-mill can be substituted in a few minutes for one that needs re-lining.

Apropos of the extensive use of reinforced concrete, numerous illustrations may be cited. The Magna plant of the Utah Copper Co. was shut-down in December 1919, and during 1920 the crushing and roughing-concentrating sections were re-built. Those who are familiar with the old plant would scarcely recognize the secondary-crushing department today. The gallery-floors, elevator-housings, rake-classifier boxes, stairways, feed- and discharge-boxes for the concentrating tables, feed-pipes for the Marcy mills, sundry launders, and miscellaneous tanks are now made of reinforced concrete.

In the Copper Queen mill, at Bisbee, concrete construction has been adopted extensively. Among the places where the use of it is novel may be mentioned the flotation-cells, which are built of reinforced concrete slabs 2½ in. thick, caulked into 3-in. grooves in the concrete floor that will form the bottom of the cell. Dorr thickener-tanks, Blaisdell tanks, and various storage-tanks likewise are constructed of reinforced concrete. Concrete is used generously in the construction of the new units in the Nevada Consolidated mill. Naturally, the companies whose ore-reserves are large, and with whom low cost of operations is more vital than low initial cost, will be justified in going further in concrete construction than will the companies whose mines have a

TABULATION OF FEATURES OF

Name of company	Nevada Consolidated Copper Co.	Copper Queen Branch, Phelps Dodge	Utah Consolidated Mining Co.	Smuggler Union Mining Co.
Name of designer	George C. Riser and D. D. Moffat	H. Kenyon Burch	General Engineering Co.	Walter L. Reid
Capacity of plant, tons per day	12,000	4000	1000	1000
Location of plant	McGill, Nevada	Bisbee, Arizona	Tooele, Utah	Telluride, Colorado
Principal metals recovered	Copper	Copper	Copper	Lead, silver, gold, copper, zinc
Breaker	McCully gyratories (2 stages)	Blake, and Gates gyratory	Telsmith gyratory	.....
Primary crusher	Rolls	Disc-crusher	Traylor rolls	.....
Secondary crusher	Rolls	Marcy rod-mill	Allis-Chalmers ball-mill	.....
Grinding mill	Marcy ball-mill	Marcy rod-mill	Tube-mill	.....
Concentrating tables used	Garfield and Wilfley	Plato	None	Wilfley
Method and purpose of table concentration	To remove a finished concentrate before flotation	Used before and after flotation to make two finished concentrates	.....	The ores are concentrated on tables in a separate plant; the tailings are treated by flotation
Tpye of flotation used	Air-cells	Air-cells	Air-cells	Air-cells and agitating machines
Secondary flotation treatment	Air-cells as cleaners	Air-cells as cleaners	Air-cells as cleaners	With one kind of ore, tailing from machine is cleaned in air-cells
Type of flotation reagents	Soluble fractions of coal-tar, and lime	Oils	'Alphabetical' reagents and lime	Oils
Method for dewatering of concentrate	Table product in Dorr classifier. Flotation product thickened and filtered in Oliver machine	Coarse-table product in Blaisdell tanks. Fine-table and flotation products thickened and filtered in Olivers	Thickened and filtered in Olivers	Concentrate classified in Dorr bowl. Coarse product ready for shipment. Fine is filtered in Portland machines

less certain length of life. The very substantial character of the construction is partly the result of, and is justified by, the simplification of the process of concentration. Five years ago a mill-designer scarcely would have been warranted in using reinforced concrete, because of the probability of having to tear it out to provide for alterations in the flow-sheet or for the substitution of new machines.

In connection with concrete I may mention the use of 'gunite' at the Smuggler flotation plant at Telluride, Colorado. The building is of structural steel, the roof of which is made of No. 22 galvanized corrugated iron, protected on the inside with a double layer of $\frac{1}{16}$-in. asbestos sheeting and two layers of tar-paper on poultry-netting. The under surface is 'gunited' for protection from cold and from fire. The walls are also coated on the inside with 'gunite', reinforced with $\frac{3}{8}$-in. 'Hy-Rib' metal lath. It should be remembered that the winters in the San Juan region of Colorado are severe.

For a long time electricity has been recognized as the most desirable form of power for operating concentrators. It is not the more general use of electricity, but rather the recent improvement and refinement of its application, that is notable. The use of individual motors for separate machines has increased tremendously. The extreme is probably reached in the Copper Queen mill, in which individual one-horsepower motors are provided for the concentrating-tables; but the tendency is evident everywhere. Among the advantages are the following: Simplification of transmission and economy of space by the avoidance of awkward line-shafts, counter-shafts, and flapping belts. Direct gear-connections or short chain-drives are almost invariably used in the newer plants. This method of applying power diminishes materially the cost of mechanical maintenance by avoiding the incessant re-lacing of belts and occasional re-aligning of shafts. It also makes the work of the operator less hazardous. Perhaps the greatest advantage, however, is the economy resulting from the elasticity of operation. Any particular machine that is not required, or that is in need of repair, can be shut-down quickly and conveniently without interfering with other machinery, provided, of course, that it is possible to divert the feed elsewhere, temporarily. Although it may be that the combined electrical efficiency of a large number of small motors is less than that of fewer large ones, this is more than offset by the fact that when a machine is not operating the total power supplied to the plant is reduced by the entire amount represented by that motor. Figuratively, with this system of supplying energy there is no 'overhead'—represented by auxiliary transmission machinery—to be divided among the individual machines.

Rapid advance has been made in the development of methods for automatic or semi-automatic control. Credit is due to the manufacturers of electrical equipment for improvements both in the design of apparatus and in the development of schemes for using it. Instead of the ticklish business of operating the old-time starting-box with the attendant danger of burning-out the motors, and of personal injury, the millman in a modern plant has only to press a button, situated near the machine

EIGHT NEW FLOTATION PLANTS

Name of company	Boston & Montana Milling & Power Co.	Simon Silver-Lead Co.	California Rand Silver, Inc.	Cerro Gordo Mines Co.
Name of designer	H. S. Gieser	W. Dunn and C. D. Kaeding	M. N. Colman	Henry Hanson
Capacity of plant, tons per day	500	150	100	75
Location of plant	Wise River, Montana	Mina, Nevada	Randsburg, California	Keeler, California
Principal metals recovered	Silver	Lead, silver, zinc	Silver, gold	Lead, silver
Breaker	Telsmith gyratory	Gates gyratory	Blake	Blake
Primary crusher	Provision for rolls to increase capacity	Kennedy gyratory	Hendy ball-mill	.....
Secondary crusher	Hardinge mill	Marcy ball-mill	.....	.....
Grinding mill	Hardinge mill	Allis-Chalmers tube-mill	Hendy ball-mill	Marcy ball-mill
Concentrating tables used	James	Universal Deisters. Wilfley	Deister-Overstrom	Buchart
Method and purpose of table concentration	In series preliminary to flotation	To separate lead and zinc minerals in the flotation concentrate	As pilots or barometers to regulate operations	To clean flotation tailing
Type of flotation used	Agitating-machine (Janney)	Agitating-machines	Agitating-machines	Agitating-machines
Secondary flotation treatment	Similar machines for cleaning	Lead floated in first machine; zinc in second	None	None
Type of flotation reagents	Oils	Oils	Oils and calcium polysulphide	Oils and sodium sulphide
Method for dewatering of concentrate	Flotation concentrate thickened and filtered in Olivers	Thickened and filtered in Olivers	Dorr thickener	Flotation concentrate thickened and filtered in Oliver

that he desires to start, and automatic devices do the rest; they supply the proper amount of power for starting and then decrease the input according to the requirements; automatic compensators provide for subsequent fluctuations. Men with little skill are able to operate the plant, and possible abuse to the electrical-, transmission-, and mill-machinery is prevented. 'Remote control', by which I mean the placing of the controlling button in an unexposed place, makes for safety to the operator. One refinement is the use of devices for 'interlocking' control. Arrangements are made so that a group of machines, the operations of which are interdependent, are controlled automatically by a single button in such a way as to assure starting or stopping of each machine in proper sequence and at the proper time. The motors for an elaborate system of belt-conveyors, for example, may be interlocked so as to preclude the possibility of costly spills such as occur frequently when belts are not started or stopped in proper sequence. The net result is that fewer men and less-skilled men are able to operate the plant at maximum efficiency. Some economy of power is a coincidental advantage.

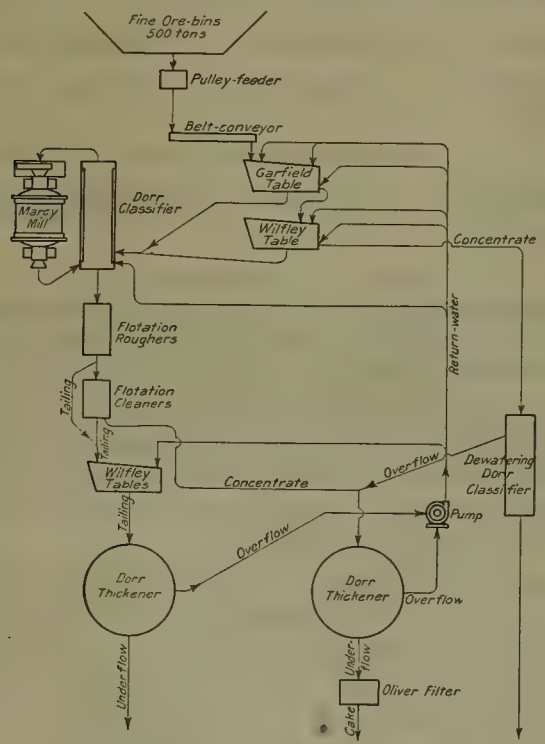
The fourth general tendency that I mentioned is the selection and arrangement of equipment that offers the best prospect of affording continuous and steady operation. Three units that can be kept in operation at full capacity 95% of the time, year in and year out, are the equivalent of four units of the same nominal capacity that are shut-down and undergoing repairs 29% of the time. This is patent, of course; but I am inclined to believe that designers of mills are recognizing the fact to an increasing degree. The wide popularity of ball-mills is due in part to the advantages derived from avoiding mechanical difficulties. Feeders that are positive as well as uniform in their operation; improved drives for all machines, as mentioned heretofore; reliable equipment for elevating and conveying material, both wet and dry; reserve or stand-by pumps and similar units; all these and other features have as one object the continuous and regular operation of the plant.

The provision of bins and tanks, as reservoirs, at various points assists in obtaining the maximum work from the plant. For instance, bins that have sufficient capacity to supply the grinding department with finely-crushed ore for a 48-hour run, can be utilized to enable either the crushing or the grinding department—which should be independent of each other—to shut-down for a day or more without affecting the operation of the other. Somewhat similar considerations prompted the General Engineering Co. to place a stock-tank between the Dorr thickeners, in which the concentrate is dewatered, and the Oliver filters. This tank affords storage that will avoid possible embarrassment from an accumulation in the thickener when one of the filters is being re-covered.

ROCK-BREAKERS. An interesting point is the selection of a 66 by 84-in. Blake-type jaw-crusher for the initial breaking of steam-shovel ore at Bisbee, in preference to a machine of the gyratory type. This breaker will be set with an 8-in. opening and will be followed by No. 9 Gates gyratories. The Telsmith gyratory has numerous adherents; it has been installed in two of the eight plants

listed in the table. It is clear that a machine of the jaw type need not be nearly so heavy as one of the gyratory type to break efficiently from coarse run-of-mine to 6-in. size. The determining factor may be whether the capacity of the plant is sufficient to warrant the installation of a gyratory breaker.

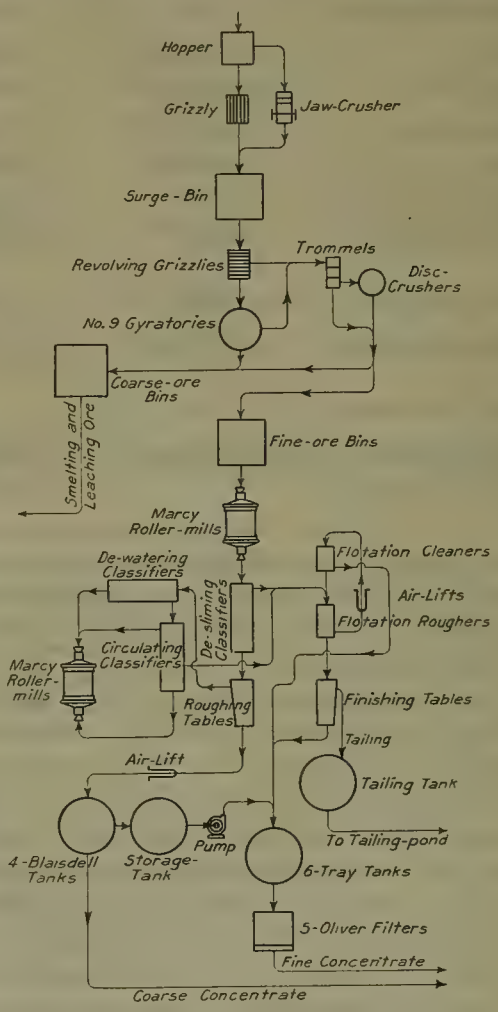
CRUSHERS. Rolls, disc-crushers, rod-mills, and ball-mills are used in reducing material of from 1 to 2-in. size, in one or more stages to ¼ or ⅛-in. mesh. Perhaps 'intermediate crushing' would be a more comprehensible term, but if 'breaking', crushing', and 'grinding' are used to designate the successive stages of reduction, crushing is the logical name for this stage. The name 'rod-mill' seems to be preferable to 'roller-mill'; it is both descriptive and distinctive; the rod-mill is a mill partly filled with rods. The one-easy-stage idea is impracticable except in small plants; indeed the number



NEVADA CONSOLIDATED COPPER CO.

of stages in which diminution from mine-ore to a flotation-pulp is accomplished, varies, roughly, in proportion to the capacity of the plant. The disc-crusher and the rod-mill are the newer machines; the fundamental idea of each is based on sound principles and each has done efficient work in actual operation. The rod-mill, in the opinion of many, seems to have demonstrated its superiority to the ball-mill, both with respect to the capacity of a mill having the same dimensions and to the consumption of steel per ton of ore crushed, although some engineers demur to the latter conclusion. It works best when the ratio of diminution is small, and when it is not necessary to reduce the ore to finer than 120-mesh. It would be suitable for the California Rand plant, in which the grinding needs to be carried only to 60 or 80-mesh.

I venture the opinion that the desire to be in style has helped to swing the pendulum toward the use of ball-mills and rod-mills for crushing (I again distinguish this from breaking and grinding), and that there will

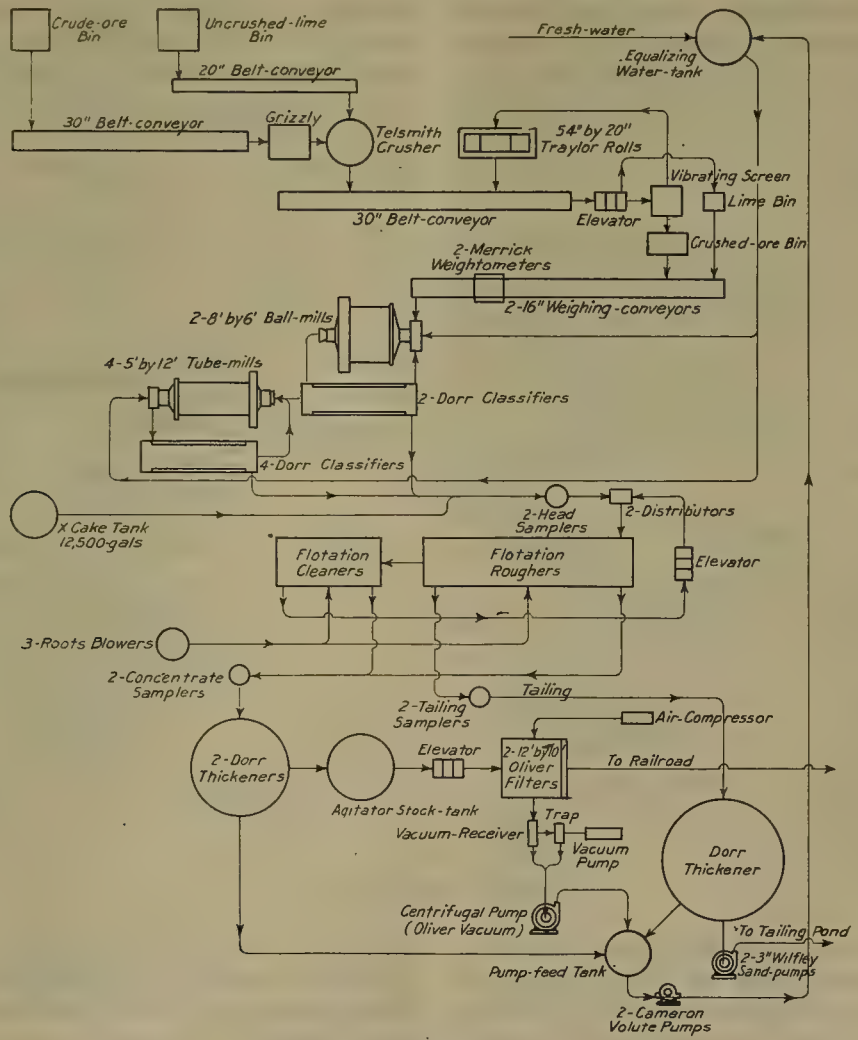


COPPER QUEEN BRANCH, PHELPS DODGE CO.

be a reaction in favor of rolls. From the standpoint of capacity and consumption of power, well-designed rolls, properly fed, are hard to beat for this class of work—that is, intermediate crushing; it is true that they require more attention, but a daily inspection, and adjustment if necessary, requires only a brief stop, and will permit the shell to be worn uniformly to a thickness of a half-inch or thereabout. In this connection I may call attention to the fact that provision is made for placing rolls between the Telsmith gyratory and the Hardinge ball-mill when it becomes advisable to increase the capacity of the Boston & Montana plant.

Apropos of the conical ball-mill, the opinion seems to be general that the advantage of the shape lies largely in the structural strength of a truss-like shell, rather than in any mysterious grinding qualities that are sometimes attributed to the cones. This view is supported by the fact that the Hardinge company is building mills with increasingly long cylindrical segments, in order to obtain capacity. There is evidence that the disc-crusher is old 20 and 22-ft. mills are obsolete; the principle that a particle should be separated from the pulp as soon as practicable after it has been reduced to the desired size, is recognized in using a comparatively short mill.

In each of the flow-sheets shown here a Dorr classifier is used in closed circuit with the mill. This seems to be standard practice and is founded upon well-established tests, except, of course, with respect to the selection of



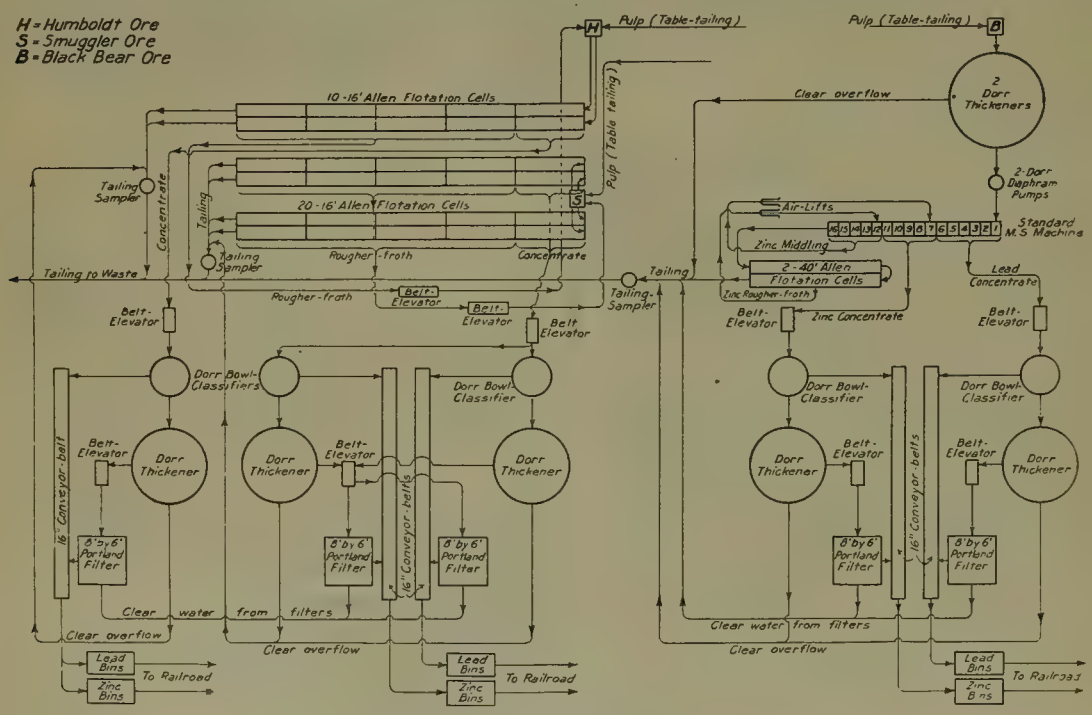
UTAH CONSOLIDATED MINING CO.

winning the advocacy of numerous millmen for intermediate crushing.

Grinding and Classifying. A ball-, pebble-, or rod-mill of some kind is used, almost without exception, for grinding. So far as I can determine, each type has its adherents, who, for reasons that seem sufficient to them, prefer one or the other. There is no question, however, but that the use of rod-mills is gradually gaining headway. The inefficiency of the long tube-mill has apparently been proved, even when sliming is desired. The General Engineering Co. has selected 5-ft. mills, 12 ft. long, for grinding so that 90% passes 200-mesh. The the Dorr in preference to a spiral machine of the Akins type. I know several metallurgists who are satisfied that they get a cleaner sand by using a spiral classifier. The Dorr machine, on the other hand, has the indirect endorsement of several companies that have constructed classifiers of their own, operating on principles similar to those of the Dorr. The use of drag-belts with angle-iron scrapers bolted onto them at intervals seems to have lost vogue in many quarters.

Table Concentration. Generally speaking, tables for gravity concentration have a place in most plants of recent design; there is, however, a wide range in the par-

ticular purposes for which they are used, virtually all of which are exemplified in the flow-sheets accompanying this article. The only plant in which no tables are found is that of the Utah Consolidated company; the reason, in this instance, is the fact that the separation of chalcopyrite and pyrite is an essential part of the concentration, and tables accordingly would serve no purpose, even as pilots. At the California Rand mill two Deister-Overstrom tables serve important, though not essential, functions. As will be noted on the flow-sheet, no separation is actually made; that is to say, all the material discharged from the tables flows in a single launder back to the circuit from which the feed is diverted. The first table, preceding the flotation machine, serves as a guide



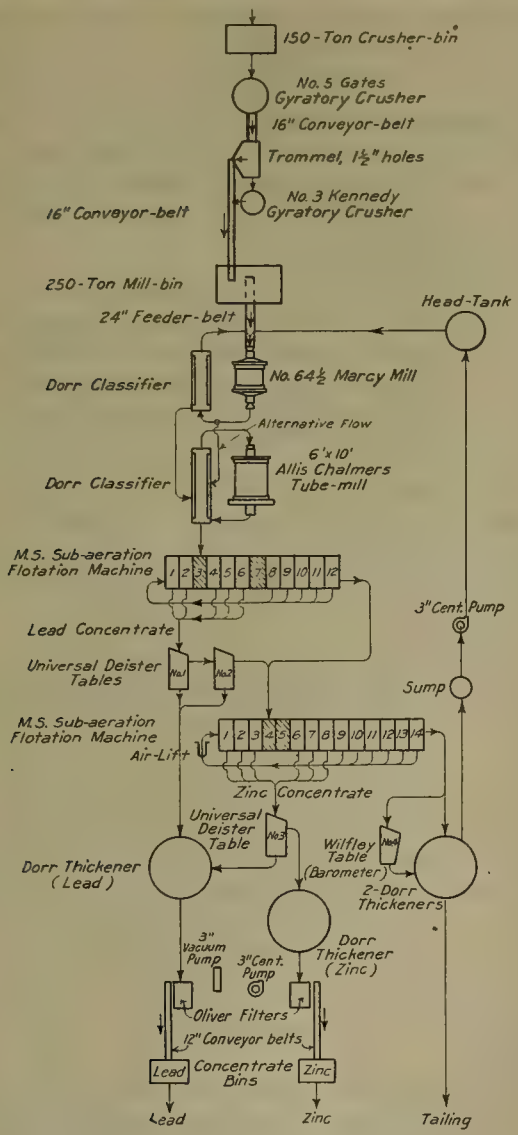
SMUGGLER UNION MINING CO.

to the millman for regulating the flotation operation; it enables him to detect immediately any changes in the richness or character of the flotation-feed so that he can determine the best rate of feed of his reagents or make other necessary adjustments. The second receives a by-passed portion of the tailing; its function is to reveal faulty work in the flotation machine. At first glance this procedure appears to be a rather belated 'post-mortem', for the reason that samples of the tailing, taken directly from the machine, could be assayed before the thickened pulp would emerge from the 40-ft. thickeners. However, the ore contains sulphides of antimony and arsenic, which carry the silver, as well as pyrite with which the gold is associated, and the table accordingly will reveal more than would a mere assay. It may be found profitable even to separate and save the concentrate, but this is not to be expected in view of the exceptionally satisfactory recovery that has been made by flotation in exhaustive experimental work. The table preceding the machine is called a 'pilot'; the second one a 'barometer'. The same idea has been adopted by the Simon Silver-Lead company, by using a No. 4 Wilfley to test the tailing. Here, however, the table is found preceding the thickener instead of following it; the former appears to be the logical position. Universal Deisters, in the Simon plant, are also used to make a separation of lead and zinc minerals in both the 'lead' and the 'zinc' concentrates. At the Cerro Gordo and Copper Queen plants, flotation tailing is to be cleaned by tables, producing in each instance a finished product. The most general use for tables, of course, is to accomplish the initial concentration to be followed by flotation of the tailing after re-grinding. It will be noted that in the two largest plants, the Nevada Consolidated and Copper Queen, flotation is both preceded and followed by concentration on tables.

There is no doubt that flotation royalties demanded by the Minerals Separation company have had an influence on the use of tables. Those who operate under M. S. license may have as an incentive for using tables the diminishing of their total royalties by choosing the schedule based on the metal recovered from such portion only of the ore as is treated by flotation. A somewhat greater milling cost may easily be justified, under some circumstances, by the advantage derived from a lessening of the royalty, effected by removing a large proportion of the concentrate on tables.

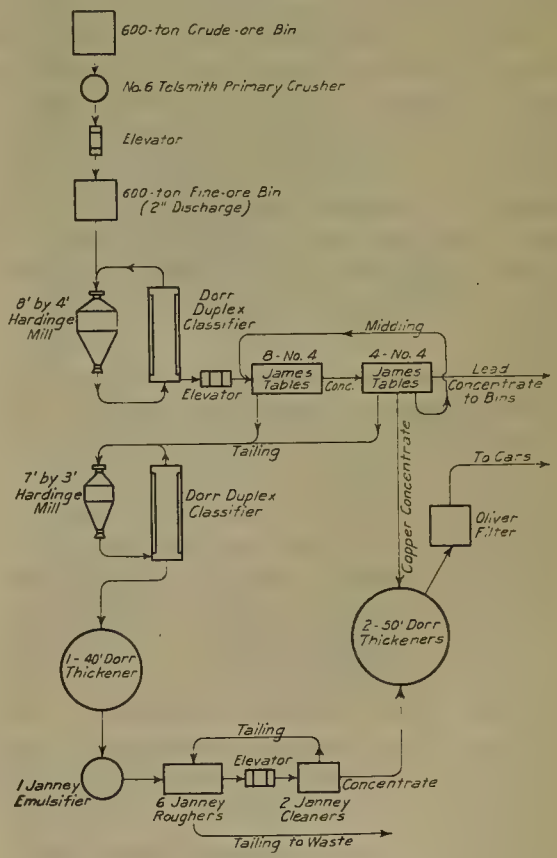
FLOTATION. The first fact that strikes one in glancing

along the line, in the accompanying table, called 'Type of flotation used', is that the large plants use air-cells, whereas the smaller ones use agitating-machines. A possible reason that suggests itself is that the big companies, which would lose more by paying exorbitant royalties, and which have the resources to engage in litigation, use



SIMON SILVER-LEAD CO.

air-cells because they afford a better chance of avoiding liability for infringement. However, the Phelps Dodge Corporation is a licensee of Minerals Separation; it pays a royalty on the process, and still selects air-cells in preference to mechanical agitators. The only possible conclusion is that the company's metallurgists have proved, to their satisfaction, that more profit can be realized from the treatment of a ton of ore by flotation with low-pressure air, introduced through the porous bottom of a cell, than by the egg-beater type of process, regardless of the question of royalty. And it is not unreasonable to infer that the same conclusion has been reached by the Nevada Consolidated and Utah Consolidated companies. I do not presume to say that all ores can be treated more advantageously by air-cells than by agitating-machines; I simply point out the fact that most companies that have large tonnages to treat have selected the air-cell. What then, if any, are the advantages of the agitating-machine? I have talked with a large number of millmen and the consensus of opinion seems to be that mechanical agitation is more certain in its results; that it is more fool-proof, as one superintendent says; or, in the words of another, it is less likely to be 'temperamental'. There are in successful operation a great many small plants using air-cells just as there are some large ones using agitating-machines; some specific ores doubtless can be treated to greater advantage by one



BOSTON & MONTANA DEVELOPMENT CO.

process than by the other, but I venture to say, simply as recording a condition, that at the present time the mechanical method is in favor with the man whose primary object is to build a mill that will produce a satisfactory concentrate every day, in spite of variations in feed or in oil, or in other conditions, and in the absence of a flotation 'expert'; whereas air-cells appeal most strongly to the man who must obtain the maximum recovery—not necessarily the highest extraction, but the greatest economic realization.

A tendency to simplify the design of flotation equip-

ment is apparent. The new standard Callow rougher, 36 ft. long, consists of twelve 3 by 3-ft. units; it is more conveniently operated and repaired, and is a much more efficient unit than the older type of Callow. The Janney equipment recently introduced is known as the Standard straight-agitation machine, requiring no auxiliary air; the machine itself is preceded by a special emulsifier. The new Minerals Separation machine has no separate spitzkasten compartment for frothing; a horizontal baffle in the agitating-compartment serves to restrict the violent commotion to the lower part, thereby permitting the froth to form and overflow without trouble. The Allen cell, used at the Smuggler Union plant, is a simple and convenient cell of large capacity. The largest single cell is a wooden box, 40 ft. long and 36 in. deep; the bottom is 30 in. wide and has no slope whatever. The sides are inclined inwardly so that, at the top, the cell is about 18 in. wide. This feature is credited with affording a decided advantage in obtaining a clean concentrate. A number of agitating-machines in which the stirring device revolves on a horizontal shaft have been developed and are in successful operation. What seems to be needed is a slow-speed machine that can be built, operated, and maintained more economically than can most of those depending upon high-speed impellers for mixing. Experimental work in this direction should prove technically profitable; but it is doubtless less attractive than it would be but for the status of patent litigation.

An interesting feature is the development of soluble flotation reagents that require no agitation; they diffuse in the water of the pulp without any stirring whatever. At one plant several thousand tons of ore containing 2 to 2½% copper in the form of chalcopyrite, and an exceptionally high proportion of pyrite, has been treated. The ore was crushed so that 85% passed 200-mesh and was floated in pneumatic cells with a mixture of alphonaphthylamine and xylidine (soluble coal-tar derivatives known as XY reagents). A distinct selective separation of the chalcopyrite as against the pyrite was effected; a concentrate assaying from 11 to 13% copper and containing 90% of the total copper of the ore was obtained.

A detailed discussion of the reagents used is beyond the scope of this article. Obviously, selective work will be required to float first the lead and subsequently the zinc, at the Simon plant; most of the lead in the Cerro Gordo ore is in the form of carbonate, and the silver is a chloride; the use of sodium sulphide has proved effectual in sulphidizing the lead and silver minerals, so that they become amenable to flotation.

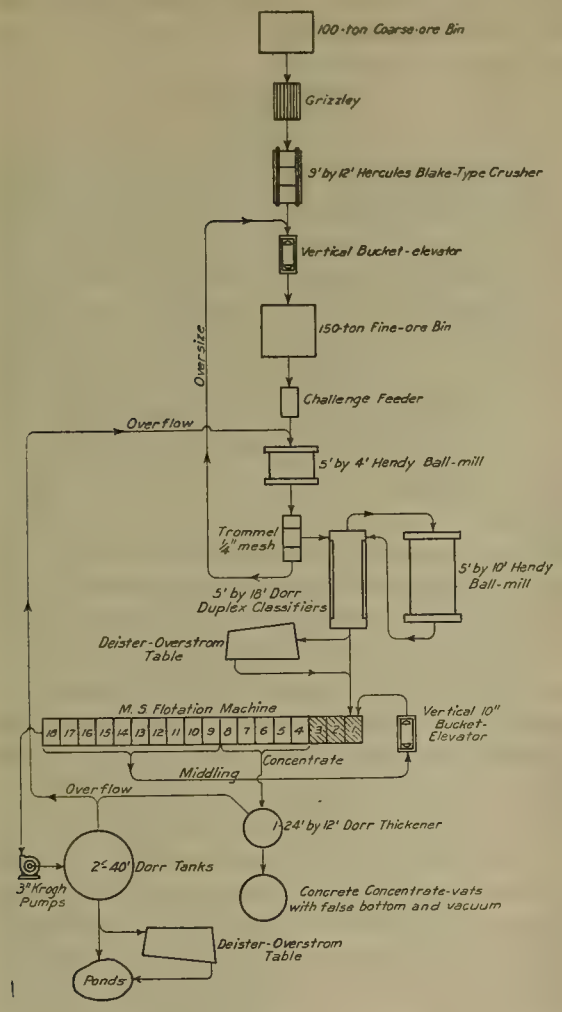
Secondary Flotation Treatment. In the larger plants the flotation treatment consists of a roughing concentration followed by cleaning of the rougher-froth in a second distinct unit of smaller size than the first. This practice has been discontinued at the Smuggler Union plant; instead, a finished concentrate is taken from the first few compartments of either the air-cells or the M. S. machines, while the froth from the remainder is returned to the head, where it joins the original feed. This is the procedure at the Simon, Cerro Gordo, and California Rand plants. The plan, of course, is especially applicable where but one flotation unit is used, but the obvious simplification of operation seems to warrant its serious consideration elsewhere. A variation in the operation of the M. S. machines is noted in the California Rand mill, in which no froth is removed from the first three compartments; they act as agitators only. A still more complicated arrangement appears in the flow-sheet of the Simon mill; in it the shading of a compartment indicates that no froth is taken from that particular one. The original feeds are introduced in the third and fourth compartments, respectively, of the 'lead' and 'zinc' machines, the returned middlings occupying the head-cells, where they are cleaned. This seems to be a sensible arrangement.

A novel alternative flow is indicated in the Cerro Gordo flow-sheet. Normally the overflow product from the classifier goes to the M. S. machine, the tailing from which enters an Allen cone, functioning as a classifier. The overflow is discarded and the spigot-product is sent to the Buchart table. The variant would be to divert the classifier product to the Allen cone; the overflow would form the flotation feed, and the spigot-product, as before, would form the feed for the table. This scheme would increase the capacity of the plant, but would probably give a lower recovery. The expectation is that the practice first described will be retained.

Dewatering of Concentrate. Here Dorr equipment seems to monopolize the field; froth-concentrate always finds its way immediately into Dorr thickeners; and almost invariably the thickened product is dewatered further by Oliver filters or, in some places, by Portland filters. Machines ranging in size from 4 by 6 ft. up to 14 by 16 ft. are used, generally with satisfaction. It is apparent that the high freight-rates make the shipment of much moisture in concentrate especially undesirable; a practicable method for dewatering froth to 4 or 5% moisture at low cost would be very acceptable; but no process seems likely to displace the vacuum drum-filter. One solution of the marketing problem is the reduction of the concentrate to bullion at the mill; this is engaging the attention of metallurgists, but it has no place in this article.

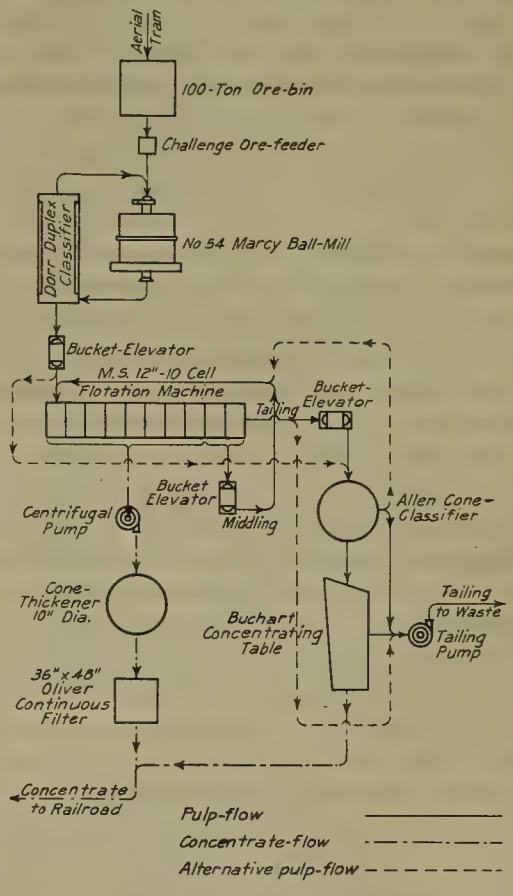
The Smuggler Union company has paid unusual attention to the design of equipment for handling the froth-concentrate. The finished product of the flotation-cells goes to Dorr bowl-classifiers for separation into a coarse product, which falls directly onto 16-in. belt-conveyors; and a slime that is thickened in Dorr thickeners. The thickened pulp is elevated to a Portland filter, placed immediately above the thickeners, and arranged with large and positive quick-discharge valves by means of which the hoppers can be emptied into the thickeners below in case of trouble from the shutting-off of power or from other causes. The elevation of the filters also permits the use of a dry-vacuum system with a barometric water-column. The removal of the coarse sand in the bowl-classifier and the provision for emptying

the filters quickly are credited with avoiding costly and frequent repairs that formerly were made necessary by the 'sticking' of the filter-drums. It should be remarked that this new plant replaces one destroyed last year by fire. The filter-cake joins the coarse concentrate from the bowl-classifiers on the 16-in. belt-conveyor and is discharged by means of a shuttle-conveyor into one of a series of reinforced-concrete drying-bins that span the railroad-tracks. These bins have inclined false bottoms of sheet-steel, under which are steam-coils for further drying of the concentrate. At the Copper Queen, coarse table-concentrate will be collected in filter-bottomed tanks and discharged by means of a Blaisdell plow-excavator. This was the method employed at the Nevada Consolidated plant before the introduction of flotation; now Dorr classifiers are to dewater the coarse concentrate from the roughing-tables.



CALIFORNIA RAND SILVER, INC.

Devices for Handling Mill-Products. Devices for more efficient feeding, conveying, elevating, and pumping have been developed. Positive and uniform feeding, subject to easy regulation, is being recognized as essential. This may be accomplished by using an apron- or pan-feeder, or some kind of a revolving-drum feeder. There are many designs of both types. Two particularly good drum-feeders installed at the Simon Silver-Lead mill are patterned after some originally built at the Dome mill in Ontario. The remodeled Challenge feeder is satisfactory in some places. The improvement in feeders has accompanied the general tendency to decrease the amount of close attention required of the mill-hands.



CERRO GORDO MINES CO.

For elevating pulp the following kinds of equipment are noted:

Copper Queen	Air-lift Belt-and-bucket elevator
Utah Consolidated	Belt-and-bucket elevator Wilfley sand-pump
Smuggler Union	Air-lift Dorr diaphragm dump Belt-and-bucket elevator
Boston & Montana	Belt-and-bucket elevator
Simon Silver-Lead	Krogh pump
California Rand	Belt-and-bucket elevator Krogh pump
Cerro Gordo	Belt-and-bucket elevator

The most significant fact here is that six of seven plants are equipped with belt-and-bucket elevators for lifting pulp. I believe that one of the important reasons for this apparent preference is a point to which I have already alluded: the importance of continuity of operation. An elevator is expensive to erect, but if it is designed properly it will run without delays and with little attention; it requires no packing and no replacements until the belt is worn out; it consumes little power. Incidentally, I may draw attention to the contrast between 'wet' elevators and 'dry' elevators. The latter are being displaced in many instances by belt-conveyors, with consequent economy of no little importance. The belt-conveyor, with idlers fitted with ball- or roller-bearings, is a deservedly popular contrivance; whether horizontal or inclined, it gives cheap, clean, and steady service.

Miscellaneous Items. A few small items are worthy of mention. One is the use of the vibrating screen for economical and efficient sizing. When its virtues are more widely known it should be used more extensively. Another is intelligent lighting of mill-buildings. Both the Utah Consolidated and Smuggler Union plants will be illuminated with a comparatively small number of high-candle-power lamps equipped with suitable reflectors and suitably placed to afford proper diffusion. Small drop-lamps, like those generally found in mills in the vicinity of each piece of machinery, have been discarded entirely. Mention has already been made of the practice of providing 'spare' or 'stand-by' pumps, blowers, compressors, and other small but vital units of the equipment. This is not new; the significant point is that the idea is being given wider recognition by those who are designing modern mills.

A Standard Mill. The treatment of every ore is a problem in itself and the design of a plant must be governed by the particular characteristics of the ore. Nevertheless it may be interesting to outline roughly the flow-sheet of a mythical 'standard' plant, choosing the equipment according to the preponderance of opinion held by a large number of metallurgists as to the merits of various machines. It will be advisable to imagine two plants. 'A' will have a capacity of 2000 tons, 'B' of 100 tons.

A	B
Gyratory crusher	Blake crusher
Disc-crusher	
Trommel	
Rolls	
Vibrating screen	
Ball-mill	Ball-mill
Dorr classifier	Dorr classifier
Concentrating-tables	
Rod-mill	
Dorr classifier	
Air-flotation cells	Agitating flotation machine
Concentrating-tables	
Dorr thickener	Dorr thickener
Drum vacuum-filter	Drum vacuum-filter

Doubtless no one will agree entirely with the interpretation of the tendencies of modern practice indicated by the selections made above. As a matter of fact, the task was more difficult than I imagined it would be. I offer it simply as being the result of my discussion with men who are actually engaged in designing, building, and operating flotation plants.

Bentonite

The name bentonite, according to a U. S. Bureau of Mines bulletin, has been applied to a group or series of clay-like materials characterized by an alkaline oxide and alkaline earth content of 5 to 10%, fine-grain size, high absorptive powers, and, usually, strong colloidal properties. Bentonite probably represents no mineral of fixed composition, and its physical properties vary considerably. The type material from Wyoming is light yellow or greenish-yellow in color, but from other localities it may be cream colored, white, gray, pink, dark brown, or even black. It is exceedingly fine grained, very plastic, and highly absorbent. The appearance may be dull or powdery, but a freshly-cut surface usually has a waxy lustre. Some varieties have the appearance of wax and may be cut into thin translucent shavings. The fracture of the type material is roughly conchoidal, that of other varieties is platy and shale-like; others have no typical fracture. Bentonite is highly absorbent; when wetted it will absorb more than three times its weight or seven times its volume of water. Some varieties when wetted with water expand to more than six times (some experimenters report eight times) their original volume. The wetted material is exceedingly smooth and soft and feels like soft-soap. Unlike most clays, bentonite is easily fusible at a comparatively low temperature. Under a high-power microscope bentonite seems to consist of extremely small, more or less rounded, grains of uniform size, but the texture of most varieties is so fine that individual grains cannot be distinguished. Some varieties, when finely ground and thoroughly agitated with water, will stay in suspension indefinitely, forming a translucent gelatinous mass. The addition of small amounts of acids or sodium chloride seems to have little or no tendency to aid coagulation or settling. Some of the minerals of the bentonite group have the property of allowing easy replacement of the alkaline and earth oxides, one with another. If hard water containing calcium sulphate be passed through a mass of bentonite containing sodium, the calcium sulphate is changed to sodium sulphate and the sodium in the bentonite is replaced by calcium. The process is reversible; the bentonite may be rejuvenated by passing through it a solution of sodium chloride. The sodium is restored to the bentonite and the calcium is removed as a chloride. It is probable that carbonates are removable in the same way. This easy replaceability of the alkaline oxides may have an important bearing upon the physical properties of the bentonites. For example, it is possible that the differences in colloidal properties of various bentonites may be due to variation in relative percentages of the alkaline oxides

Electricity in the Development of the Mining Industry

By Girard B. Rosenblatt and Graham Bright

*The subject that interests all industry most fundamentally is money. The mining industry is no exception. The future of electrical power in the development of mining depends upon what it can accomplish expressed in terms of money. It is our intent to outline briefly some ideas regarding the influence of electrification upon the lessening of mining costs. We will endeavor to point out the lines along which such development may logically be expected, and the things that may be anticipated during the next decade in the way of electric-power supply for mining and metallurgical operations.

Further use of electricity in the mining industry will most logically be along three lines, namely:

(*a*) The displacement of manual labor.

(*b*) The supplanting of present steam by electric power.

(*c*) The development of new metallurgical processes.

(*a*) Electric power will replace manual labor more and more as the supply of cheap labor continues to decrease, and as the laboring man develops an objection to monotonous occupation, which objection is always incident to an improvement in the standard of living. Mining and metallurgical operations consist largely of moving and treating material in bulk. Man-power, except in special and specific instances, is not a cheap way to move bulk material. Electric power is the most logical substitute because of the flexibility of its application, the economies that may be affected by its use, and its reliability when properly installed. Already the electric locomotive, in the smaller sizes, has displaced largely hand-tramming; mechanical shoveling machines are replacing the 'mucker' underground; while scoop-loaders, bucket-elevators, and belt-conveyors continue to replace shovels operated by men with strong backs and weak heads. Further developments in the replacement of manual effort by electric power will depend upon a realization of what can be saved by displacing human labor, and upon the development of equipment and machinery that will be more flexible than present apparatus, that can be operated more accurately to simulate the action of an efficient man, and that can be economically purchased in units small enough to displace a small group of men in handling small tonnages. The advantages of mechanical handling today are generally appreciated when large tonnages are considered. Further progress will come through the perfection of equipment to displace manual labor in the handling of smaller tonnages, and the education of the public toward appreciating the advantages of such equipment.

(*b*) Electric power will supplant steam power as hydro-electric energy distributed by public-service corporations becomes more generally available, and as methods of generation become more efficient. Already we see the net-works of the big central-station organizations of the country spreading out over the mountains to localities where basic raw materials are being produced. Where such central-station power is available the increase in the use of electricity will be rapid. Where central-station power is not available, as in some of our desert regions, wider use will depend upon the obvious economies of generating electricity in bulk and applying it in parcels to the performance of mechanical operations. Electricity as a power for hoisting, pumping, ventilating, compressing air, transportation, and milling, is inherently more economical than steam under most conditions, because of the high efficiency of electrical equipment, the convenience of its use, its low maintenance charges, and its operating simplicity. The increased use of electricity in performing those operations now very commonly performed directly by steam depends upon the education of the using public properly to view their power problems as an entity, and not to base decision upon a comparison alone of tabulated efficiencies of individual equipment.

(*c*) One of the greatest opportunities for the lowering of metallurgical costs lies in the commercial development of processes using electric power directly for the production of thermal effects, and for electrolytic action. Electric furnaces have come to stay in the production of ferro-alloys. It is to be expected that eventually electric smelting of certain of the base metals may be feasible and economical. Such smelting would permit the operation of many isolated properties at a decided advantage. In the meantime great strides are being made in direct precipitation of pure metal from liquors produced by the leaching of mine ores, such as the production of copper at the plant of the New Cornelia Copper Co. at Ajo, and of zinc at the plant of the Anaconda Copper Mining Co., at Great Falls.

Experiments that have been conducted in the direct production of what in the past have been considered fabricated articles, like copper 'shapes', have been most encouraging; we believe that in the not far distant future we may expect to see material, which has always been considered as of secondary manufacture, produced directly by electrolytic action in the leach-liquors resulting from the direct treatment of ore.

In the final analysis, the further utilization of electric power in the mining and metallurgical industries will depend upon the answer to the question: Does it pay? To obtain a true answer to this question it is necessary that we consider the entire problem presented in connection with any given application. It is not sufficient, nor proper, to examine and compare the first costs and effi-

*A paper prepared for the convention of the American Mining Congress at Chicago in October 1921.

ciencies of electric power with those of some other method of performing a desired operation. The proper way to study the problem is to consider all of the factors that may affect results, and then to determine comparative unit costs. In mining and metallurgy this almost invariably resolves itself into costs expressed in 'cents per ton'.

A fair examination of the individual problem at each mine will frequently show that the application of electricity will effect a saving. Reduced cost per ton means a greater profit on ore mined, and the extension of ore-reserves, because lower-grade ore can be worked within the limit of permissible cost. This is the basic reason that further utilization of electric power is assured in the mining industries.

In discussing the relative cost of electric and of other forms of power, it is not proper to consider the unit cost of power purchased or generated. Rather should we look to the unit cost of power involved in the results accomplished. For instance, in considering the cost of hoisting with steam, generated locally, as against the cost of hoisting with purchased electric power, it is not proper to compare the pounds of steam used by the steam-engine with the kilowatt-hours of electric power purchased for the electric hoist. Other factors enter into the problem. There are the standby losses for the steam-plant when the hoist is not in operation. There are the maintenance costs of the entire steam-plant from coal-pile to crank-pin, to be balanced against the maintenance of the electric equipment. Further, there is the matter of considering whether the flexibility of the electric hoist may not permit a more economical hoisting schedule than would be used with a steam-plant that cannot be left idle without incurring a loss. What the mine operator really wants to know is whether the steam-hoist or the electric-hoist will mean a greater charge per ton for ore brought to the surface; and no factor that enters into this cost should be overlooked in making a fair comparison. The unit cost of energy is only one of the factors that enter into the total which must be considered.

There are three lines along which intelligent study may aid the mine operator to reduce his cost per ton mined by the proper utilization of electric power.

The first is the wise selection of apparatus to do the work that must be done. The second is the efficient scheduling of operations in order to use the power purchased or generated to the best advantage. The third is the possible reduction of the unit cost of power.

The wise selection of electrical apparatus reduces power per unit of work accomplished, eliminates interruptions in operations, and decreases the item of labor required for attention to the process, and for the maintenance of the equipment.

Experience is one of the best guides in the selection of the best equipment to do particular work; but past experience of others should not be followed too blindly. The art of making electrical apparatus is advancing—and advancing rapidly. Holding to past practice, however successful it may have been under conditions that are also past, is frequently a stumbling-block in the road of progress. The best guide to the proper selection of electrical apparatus is intelligent engineering based on a proper understanding of the fundamental characteristics of electrical apparatus, backed by extensive experience in its application. Today the larger electrical manufacturers are prepared to furnish such engineering guidance to the mine operator.

The use of synchronous motors, in and about mines and milling plants, offers a fruitful field for the reduction of costs by the proper selection of apparatus. A few years ago the synchronous motor was considered to be an unreliable and complicated piece of apparatus. Until comparatively recently this reputation was probably justified. Today the design of synchronous machinery is so well understood that synchronous motors can be applied advantageously to many drives that have in the past been cared for entirely by induction motors. The synchronous motor of today can be manufactured with characteristics to meet the requirements of a large variety of loads, all the way from driving pumps and air-compressors to driving crushers and mills. In its modern form it is a machine easy to operate and control, and it has decided advantages for many applications. For very high speeds and for low speeds it is frequently cheaper to buy, and in almost all cases it has higher efficiency than induction motors for the same work. Its use permits the improvement in power-factor in return for which many power companies are willing to make concessions in their contracts. Its capabilities for correcting power-factor are of further interest to mining companies for the reason that synchronous motors reduce losses in their distribution system, increase the effective capacity of their transformer stations, and improves the regulation of their power-plant supply. The importance of the synchronous motor to the widespread distribution of electric power over long distances, with a resultant economy that must eventually be reflected in lower power-rates, has been capably placed before the engineering profession, by F. G. Baum, in his paper delivered before the American Institute of Electrical Engineers, at the convention held in Salt Lake City, in June 1921.

The developments of automatic and semi-automatic control of electrical equipment has made great progress in the past few years, and it may be expected that in the further use of electric power, mining companies will take full advantage of such control systems. Automatic and semi-automatic control allow large savings in cost by reducing the number of operators required, by permitting equipment to be operated by less skilled labor, and by reducing the consumption of power. Automatically controlled substations are now in use on the haulage systems of some of the larger coal mines. Semi-automatic battery-charging systems are used quite extensively in connection with storage-battery locomotives. Semi-automatic hoisting has been in successful use at Inspiration for several years. The Phelps Dodge Corporation has just installed semi-automatic control on the motors throughout the new Copper Queen concentrator at Bisbee.

Proper scheduling of operations reduces costs by ac-

complishing the greatest amount of work for a minimum expenditure for power. Such scheduling depends upon the conditions under which power is generated, or upon the terms under which it is purchased. Frequently a great saving can be effected by the elimination of peak-demands that might be occasioned through the concentrated or simultaneous performance of operations. These might be arranged by proper scheduling to succeed one another so that their power-demands would not be coincident. Much good work along these lines has been done by some of the larger mining companies.

An example of practice in the scheduling of operations to reduce peak-demands, is the operation of coarse crushers in one shift per day, choosing that shift when other operations require a minimum of power. Such practice, of course, means adequate storage capacity between the coarse-crushing and the subsequent milling operations. The investment in such storage-capacity frequently shows an excellent return, due to the saving in operating charges accomplished by reducing peak-demand for power. Another instance not infrequently met, is the charging of storage-battery locomotives during the 'off' shift.

Other opportunities for scheduling operations around the mine and mill so as to reduce peak-demands often exist. For example, it is sometimes feasible to arrange for hoisting ore during periods when the power requirements for other operations are at the minimum. Frequently peak-demands may be reduced by slowing the speed of hoisting so that the maximum demand for power is kept low. Reducing the speed of hoisting naturally lengthens the period required to hoist a given tonnage. Often it is economical to do this rather than to try to hoist all the ore in the minimum length of time.

Some of the larger mining companies in this country have extensive enterprises which consume a large portion of the power from the hydro-electric systems supplying the districts in which they are located. The thought is suggested that some of these large organizations could economically install a system of load-dispatching so that the daily power requirements of their various enterprises could be balanced without interfering with production, yet in such a manner that their total requirements could be met with a smaller investment by the public-service corporations to such an extent that more attractive power-rates could be allowed. Of the possibilities for reducing the unit cost of power, more will be said later.

Where hydro-electric or other forms of central-station power are available, electricity is in common use for pumping, compressing air, hoisting, and milling. Even in such localities, however, individual steam-plants, particularly for hoisting, are not altogether unusual. Rare, indeed, is the mining camp that does not exhibit one or more mines that do their hoisting at least with steam power, despite the fact that cheap electric power is available. Frequently these steam-plants are retained largely because of prejudice against electric power, and the fallacious idea that steam-hoists are more reliable. An unprejudiced analysis almost invariably shows that the reliability of electric hoisting is superior to that of any isolated steam-plant, and that the possible saving due to electrification would quickly return the investment required to permit the replacement of steam power with electric power.

The rapid progress in perfecting mechanical shoveling machines, haulage equipment for small tonnages, car-loaders, car-dumpers, and excavating equipment, offers a big field for the further use of electricity in mining. We expect rapid developments along these lines within the next decade. Other developments that will tend toward further electrification, even though little power is involved, include the perfection of portable electric miners' lamps, shot-firing by electric means, and radio communication between headquarters and remote properties.

In addition to the saving in cost per ton that may be made by the proper selection and application of electrical apparatus, and by the proper scheduling of operations to get the most out of every dollar's worth of power used, there is reason to believe that in the future further savings in the use of electricity may result from a lessened cost per unit of power. The hope for such reduction lies not so much in the increased electrical efficiency of generating or transmission equipment as in the more economical generation and delivery of electrical energy through the adoption of what has been termed the 'super-power' idea.

The idea of a super-power system was conceived by W. S. Murray with the particular idea of reducing fuel-consumption and increasing the reliability of electric power, in the north-eastern portion of the United States, at a time when both these matters were of extreme importance to the continued economical welfare of the nation. However, the idea is not applicable to that particular territory alone; in a modified way it can be applied to the Western regions fed in the main by hydro-electric systems, for which fuel-burning plants are used only as auxiliaries.

Essentially the idea of super-power involves an interconnection of existing power systems in such a way that the power-supply of a large territory, covering possibly a considerable number of States, may be obtained from a general transmission-system, into which all of the various generating plants feed their output. The general transmission system acts as a sort of equalizing reservoir, much as does the receiver in a mine air-compressor system.

The particular advantages to be gained by such wholesale operation include the following:

(1) The large diversity factor in the loading of such a system will permit operating all generating equipment and all trunk-line transmission-busses at very high load-factor with consequent economy.

(2) The production of power can be cared for in efficient large units, and the wasteful small plant operating at poor load-factor can be discarded.

(3) A united system of this character can take full advantage of the maximum run-off in various streams used for production of power because, due to geographic and climatic differences, the period of high water will not be coincidental in all streams feeding the system.

(4) It would be possible to develop on a profitable

basis certain hydro-electric power-sites which hitherto had been considered uneconomical due to their distance from the load-centre, even though the unit cost of development at such sites was low.

(5) Power-supply from such a system would be practically free from any interruptions, and continuity of service would be virtually perfect.

(6) A single investment in costly transmission-lines would serve, in whole or in part, a number of generating systems with the consequent distribution of overhead costs over tremendous amounts of delivered power, thus reducing the fixed charge to be carried by each unit of power delivered to the consumer.

Our large public-service organizations in the West recognize all of the basic principles involved in the idea, and incorporate them in their individual operations. Mr. Murray's idea is simply an extension of approved practice to a scale that would permit further economies for the benefit of both the users and producers of power, and for the conservation of our national resources.

Under the conditions that obtain in the Western mining regions the super-power problem is largely one of economical long-distance transmission of electric power. The solution of this phase of the problem is one in which the consumer, as well as the producer, must play his part. As pointed out by Mr. Baum in his excellent presentation referred to above, the addition of synchronous-motor load materially reduces the difficulties of long-distance high-voltage transmission, which gives us another angle from which to view the advantages to be derived from the proper selection of electrical apparatus to assist in reducing the cost of mining.

In closing it may perhaps be of interest to present some data as to the interdependence of the electrical industry and the mining industry. You may be interested to know to what extent the mining industry is at present a user of electric power, and to what extent the electrical industry is a user of mine-products.

During the year 1920 the power generated in the Western States, which embrace the region in which are situated a large proportion of the mines of this country, there was generated a total of approximately 8 billion kilowatt-hours of electrical energy. Of this total about 6⅛ billions was generated by public-service corporations and sold. The electric power used by the mining industry amounted to about 1¼ billion kilowatt-hours, or roughly 20% of all the power sold by the public-service corporations.

During the same year 1920 one of the two largest electrical manufacturers in this country built about 2¾ million kilowatts of electric-power equipment, and to construct this equipment it used practically 40,000,000 lb. of copper, 850,000 lb. of zinc, 750,000 lb. of lead, 300,000 lb. of asbestos, and 650,000 lb. of mica.

These figures will give some idea of the importance of these industries each to the other; this importance will be magnified still more as a result of the growth of the mining industry that will be permitted by further development, and further use of electric power in mining and metallurgical operations.

Hot High-Nitrogen Gas in a Metal Mine

While investigating the presence of heavy strata gases in certain mines of the East Tintic mining district of Utah, a small local body of light, very hot gas of high-nitrogen composition was noted in one of the mines, states G. E. McElroy, in a U. S. Bureau of Mines bulletin. Observations and analyses indicate that this light gas was resulting from very rapid oxidation of finely disseminated pyrite, in lead-silver sulphide ore. The gas was actually mine-air which had lost a large proportion of its oxygen by reaction with the pyrite. This body of gas was hanging in a local high-spot about 5 by 5 by 5 ft. in size, caused by caving, at the end of a cross-cut. Fifty feet from this spot, an air-current of 6000 cu. ft. per minute was entering the 5 by 7-ft. cross-cut from a raise. On account of the vapor contained in the gas, the bottom level of the gas could be plainly seen and was practically a horizontal plane, but of slightly wavy appearance, coinciding with the point where an acetylene light was extinguished. This body of gas was visited on three occasions and samples obtained by means of evacuated bulbs and by water displacement. The temperature of the gas was approximately 175°F. on all three occasions, so that sampling required thick gloves and quick action. Air three feet below the vapor-line had a temperature of only 120°F., and a relative humidity of 27%. The stratification of the air and gas mixtures was so sharply defined that the sampler could hold his head a few inches below the vapor-level for an appreciable period of time without any noticeable effect other than that due to the high temperature. At one foot below vapor-level, it was 135°F., and the relative humidity was 30%. When a candle and an acetylene light were raised into the gas from below, the candle flame was extinguished at a point two inches lower than the acetylene flame, indicating a drop in oxygen content from about 16% to 12% (oxygen content of normal dry air, 20.93%) in two inches. The analyses and air-free calculations made show that the gas is black damp (defined by Haldane, the English physiologist, as an accumulation of carbon dioxide and nitrogen in proportions larger than those found in atmospheric air) composed almost wholly of nitrogen. That the process of oxidation was still in rapid progress was evidenced by the fact that, although the body of gas occupied not more than 150 cu. ft. and the vapor-level was practically constant, a thin stream of hot gas, estimated at 25 cu. ft. per minute, was flowing along the roof of the cross-cut to the air-current 50 ft. away. The tendency of such a mixture of air and gas to hang to the roof is due to its lighter weight as compared with the mine-air. The difference in weight is due primarily to temperature and humidity. The gas had a musty, sulphurous odor and a suffocating effect when breathed. Attempts to prove the presence of sulphuric-acid vapor in the body of gas were not determinate, although a slight amount was undoubtedly present. The presence of this gas in this mine probably represents the first step in the production of certain heavy strata gases high in carbon dioxide that affect mines in this district.

Impressions of a Journey to Europe

By P. B. McDonald

Columbus was more than two months in crossing the Atlantic, as were the Pilgrim Fathers more than a century later. Although the great liners now make the trip in a week, even the largest of them—a colossus longer than the Woolworth building is high—rolls and shakes in a storm despite the best efforts of modern seamanship. However, a consistent speed of a mile every three minutes for several thousand passengers is a remarkable achievement, and the comfort and cleanliness would make the scurvy-ridden sailors of the old wooden sailing vessels gasp with astonishment. The three thousand miles from New York to Europe can be traveled more comfortably than the three thousand miles from New York to San Francisco.

If the traveler to England goes by a British boat, the week of British conversation and British food prepares him for what is coming. They converse differently from Americans, ending sentences with a rising inflection and sniffing a bit at social inferiors, while their cooking shows less imagination than that of an American contractor's camp. There is a restraint in the atmosphere of England, a sort of obstinacy, as seen in the opposition of their workmen toward changes of design and method; an American professor with whom I talked described it as a woodenness of manner, an inbred devotion to the old ruts. Yet no one can deny that the British do many things better than we Americans. They have a respect for leadership that brings men and matters into a right proportion, and some of their leaders are broader types than could exist in America. For example, the London 'Times' printed recently a series of articles on road reform by Lord Montagu of Beaulieu, a product of Eton and Oxford who has traveled over the world observing methods of transportation, owns 10,000 acres of land, and is interested in wild-fowl, music, and literature. Because of his wide experience and interests, his articles were a discussion of highway construction from the point of view of the engineer, the financier, and the land-owner; that is, he had a broader grasp of the subject and could express his ideas more clearly and attractively than one who was merely an engineer. Moreover it is doubtful whether any American newspaper would devote so much space to one man's opinions on a technical subject.

I did not see in England many representatives of the type of engineer-administrator which America produces in large numbers, executives trained in engineering such as Hoover, and his assistants in the Belgian Relief, or Ketchum and his staff, who administered the war-built town of Nitro, in West Virginia; yet I met in London men who combine a knowledge of pure and applied science to a degree that Americans do not. Many of these scientific thinkers could not make a living in a democracy because they neither bluster nor conform to office regulations, but living in an aristocracy they are able to do important and valuable work because someone recognizes that intellect can not be standardized into quantity-production but must be allowed to develop as it will. The interest taken in the United States by British newspapers is greater than the interest in things British taken by American newspapers, for the British foresee a commercial rivalry that means a great deal to them, and some of them are not especially friendly toward Americans for that reason.

Going across the English Channel is like going to another world. There is much in England that resembles America, but the American in France feels himself in another civilization. To me it appeared as a survival of the Roman Empire, for the Romans civilized western Europe and held dominion over it for centuries. As the distinguished editor of the 'Engineering News-Record' has remarked, Paris is a triumph of artistic city-planning and is a city that is grown and complete rather than in the transition stage of American cities. The culture of the French is seasoned and mature; it is not in the Main Street stage. One could scarcely observe French families sitting on the beautiful boulevards drinking moderately of wine and beer, with no one getting drunk, without comparing the scene with prohibition America where bad whisky is sold at high prices behind closed doors. The excellent manners of the French were a marvel to me; it is truly a revelation how important manners can be. On the other hand the red-tape of bureauracy and government control is much worse than anything at Washington, and the French are as conservative in many ways as are the British; particularly is French labor antagonistic to improved methods and modern efficiency. However, the French roads are worthy of much praise, as is also the Parisian subway system, both of which E. J. Mehren described in his letters in the 'News-Record'.

Paris is not so modern and fashionable as it is medieval and classical. The slender Eiffel Tower rises over the city to proclaim the new era of steel and the conquest of nature, but life in the streets below harks back to the old Mediterranean civilization that discovered how to live before it bothered about machinery. It is in understanding how to live that the French excel, and so attractive are their boulevards, their art, and their food, that it is something of a shock to pass into Germany; for the Germans, though industrious and thorough, do things with a heavy touch.

Germany seemed depressed only in places. Certain industries that require costly imported raw materials were more or less at a standstill, but many other industries were busy and fairly prosperous. Wherever skilled labor is the principal item in manufacture, German products were competing favorably with those of other countries. Labor, of course, is plentiful and willing to work hard and long. The German people have been unsettled and dazed by the War, and their political sense is not so resistant as that of the Anglo-Saxon, but they are as yet too close to the catastrophe that befell them to realize what it all signifies. Most are continuing their hard work and pushfulness from mere force of habit. As several observers have pointed out, automobiles are scarce

and some cities seem dispirited and saddened, but such are the natural consequence of a long war. On the whole, Germany does not appear worse off than one would expect. The inconvenience of passport regulations and police permits is notably bad in Germany, and travelers are expected to report to the police of each city that they visit, though no one explains this to them. However, there is consolation in the benefit of exchange, and the dollar is particularly potent in Germany. Hotel rooms at 30 or 40 cents per night, and meals at 25 to 30 cents astonish anyone accustomed to New York prices. Moreover the Germans do not suffer so much from this depreciation of the mark as some reports indicate, because their printing-presses have been so busy making paper money that it is fairly plentiful among the population.

Holland has a cosmopolitan tone. It possesses a combination of German, British, and French civilization, and its sturdy burghers have invested in many remote parts of the world. Its wealth is much greater than that of Belgium. Belgium is a little France, and much of the description of France applies also to Belgium.

An American returns to the United States with a new appreciation of what his people have done in building up a great nation; his patriotism is increased by a sojourn in the older countries. A European trip is worth while to give this sense of values and to furnish a temporary detachment from the standardized routine in America. To learn to know one's own country, take a trip abroad.

Loading Converter Matte

By Frank Taylor

*At Copper Cliff the finished converter-matte is poured into cast-iron molds, of which there are 14, housed in a matte-shed along one side of the main converter-building. These 14 molds are divided into two sets of seven each, placed at opposite ends of the matte-shed. Each mold is about 36 ft. long by 6 ft. wide and 4 in. deep, and when full holds approximately seven tons of matte. They are of sectional cast-iron and are held together by tie-rods. The joints are made tight by retort cement. Each mold is divided into five parts by means of sections having a rib on the upper side extending across the mold, except for an 18-in. gap in the middle. This rib creates a line of weakness across the matte after it has solidified, and thus facilitates breaking.

Previous to 1917, the ribbed sections were not used. Men working with bars removed the matte from the molds in the form of large irregular slabs, and these were rolled on short pieces of heavy pipe to the floor alongside, where they were broken up with sledge-hammers to a size convenient for handling. The broken matte was then loaded by hand into wheel-barrows, in lots of 400 lb., and wheeled on to an escalator which in turn carried it to a platform at the level of the decking of a standard-gauge railway car, into which it was then wheeled and dumped. This method entailed a considerable amount of manual work, and when, in the summer of 1917, labor became scarce, and production was being increased, it was realized that some mechanical method must be devised for loading the matte—or, at least, some method that would accomplish the loading with a minimum of labor. The system described herein was evolved, and has been found satisfactory.

Over each group of the matte-molds there has been erected a trolley-crane, on I-beams which extend the length of each group. The crane consists of one 10-in. I-beam, hung on 4-ton Brown trolleys. From this I-beam is suspended an air-lift, 12 in. diameter with 6-ft. stroke, capable of raising four to five tons with air at 80 or 90 lb. The air-lift is supplied with air by a hose which is hung on a cable running parallel to the crane-track beams. The crane is moved by an electrically-operated double-drum hoist, with ¼-in. cable attached, and passing over a return-sheave at each end of the matte-shed. The hoist is situated between the two sets of molds already mentioned, and is on a level with the crane beams, both of which are operated from this point.

Before the matte is poured into the molds, a cast-iron lifting-block, with an aperture for a hook, is placed in the centre of the area marked out by a pair of ribs, and at the same time the molds are given a lime-wash to prevent the matte adhering to the iron. Soon after the matte has solidified, and while it is still hot, the crane comes along and the air-lift is hooked to the lifting-block. In this way a slab of matte, about 6 ft. square and 4 in. thick, and weighing about 1½ tons, is picked up and transferred to a loading-station, of which there are two, one at each end of the matte-shed.

The loading-station consists of a set of grizzleys at the floor-level, made up of standard 80-lb. rails in cast-iron chairs. Below the grizzleys is a small concentrate pocket, in which stands a side-dump, steel car that has a capacity of 2½ tons of matte. The matte is broken by sledges to pass through the grizzleys; when the car has been filled it is drawn up a short inclined track, by a Turnbull electrically-operated hoist, into a standard box-car for shipment. This hoist is housed in a small building outside the matte-shed and on the opposite side of the standard-gauge track on which the box-car stands. The controller for the hoist is inside the matte-shed and close to the loading-point, which enables the operator to see the small car from the time it leaves the loading-pocket until it is drawn into the box-car.

*Abstracted from a bulletin of the Canadian Institute of Mining and Metallurgy.

IMPORTS of antimony into the United States showed an increase of about 76% in quantity and 68% in value in 1920, as compared with 1919, according to a U. S. Geological Survey report. Imports of metal rose 75%, owing to increased shipments from China and England; those from China increased 175%. Large quantities of antimonial lead are imported into the United States as type metal. The United States also uses annually about 2100 tons of virgin antimony contained in domestic antimonial lead and 3500 tons of secondary antimony recovered from old alloys, scrap, and dross.

ACCUMULATION OF SCRAP-BRASS NEARLY CONSUMED —WILL HELP COPPER

A final clean-up of stocks of brass scrap has been taking place both here and abroad during recent months. For many months these holdings had a direct and detrimental effect on the copper market. However, the supplies of this kind of material fit for re-utilization at first-class manufacturing plants have decreased greatly since July. Producers and consumers were specially interested in the recent sale of British government holdings of brass-scrap to important financial interests. According to London advices the quantity of scrap metal disposed of was approximately 140,000 tons. The price at which the material was bought in was £24 per ton.

The price quoted was considered low. It appears that the material involved included, besides cartridge cases, all other classes of brass-scrap, some of a very inferior kind. The bulk of the material was not 70-30 mixture, but the commoner brass of 60-40 mixture. The 70-30 material is being gradually used up, but the 60-40 is a drug on the market. The syndicate which bought this material had to pay cash for the stuff as it lies in the various depots. Reputable manufacturers of metal products will not run the risk of using a poor quality of scrap alloys. They require clean high-grade metal in order to avoid dirty and defective finished products.

ANACONDA COMPANY SUED FOR $100,000

Suit for $100,000 in alleged unpaid Federal taxes plus penalties totaling about 130% of that sum, was filed in United States district court in New York recently against twenty-four former directors of the seven mining corporations absorbed in 1910 by the Anaconda Copper Mining Co. The complaint alleges the directors failed to report in 1909 on profits of $9,509,063 as required by the corporation profits tax law of August 5, 1919. The defendants include John D. Ryan, William Rockefeller, H. H. Rogers, William G. Rockefeller, and Adolph Lewisohn.

The corporations named in the complaint were the Amalgamated Copper Co., Boston & Montana Con. Copper & Silver Mining Co., Butte & Boston Consolidated Mining Co., Butte Coalition Mining Co., Trenton Mining & Developing Co., Parrot Silver & Copper Co., and Washoe Copper Co.

UTAH CONSOLIDATED ACKNOWLEDGES DAMAGES OF $1,079,734 DUE UTAH-APEX COMPANY

The United States Circuit Court of Appeals in Denver has confirmed the decision handed down by Judge Tillman H. Johnson of the District Court, Salt Lake City, in favor of the Utah-Apex Mining Co. in the litigation between that company and the Utah Consolidated Mining Co. There were six cases in all involving suits and counter suits. The Utah Consolidated in its suit claimed $3,000,000 from Utah-Apex for alleged illegal extraction of ore from the Yampa limestone apexing in the former's territory. Utah-Apex claimed $1,750,000 from Utah Consolidated for ore extracted in the Dana or Leadville vein apexing in the property of the former. In both of these suits Utah-Apex won a complete victory in the lower court and is now sustained in the higher court. Under the court's decree Utah-Apex was awarded a verdict entitling it to damages from Utah Consolidated for illegal extraction of ore. The latter filed an accounting admitting that in the four years, from 1917 to 1920 inclusive, it had mined from Utah-Apex property ore valued at close to $659,000 principal and interest. The Utah-Apex protested this accounting, and the Utah Consolidated has recently filed a revision in which the tonnage of lead ore extracted is given as 108,150 tons and the amount due Utah-Apex is acknowledged to be $1,079,734.

MILLION-DOLLAR CONCENTRATOR FOR BRITANNIA COMPANY ON HOWE SOUND

The directors of the Britannia Mining & Smelting Co. have authorized the expenditure of $1,000,000 for the construction of a 2500-ton concentrating plant, near the mines on Britannia Beach, to replace the one destroyed by fire last February. The crushing machinery has been ordered from the Taylor Engineering & Manufacturing Co., of Allentown, Pennsylvania, and will be shipped by way of the Panama Canal. It will consist of one 20 by 72-in. set of rolls, four 20 by 54-in. sets of rolls, and eighteen 7 by 10-ft. tube-mills. The construction of the plant will be supervised by Bradley, Bruff & Labarthe, of San Francisco.

NEW RAILROAD FOR NORTHERN ONTARIO WILL BE CONSTRUCTED

The Canadian Light Railway Construction Co., organized to build a railway to open the mining districts lying east and west of Swastika, has been reorganized and has taken over the charter of the Northern Light Railways. It will proceed at once with the construction of the road. Engineers are in the field and preliminary work is under way with a view to pushing construction as far as possible before severe weather sets in. The line will be of standard-gauge; light rails will be laid at the outset, which can be replaced later with heavier steel should the traffic require it.

MINE OPERATORS PLAN TO HELP REVIVE FOREIGN COMMERCE

Representatives of metal-, coal-, and oil-mining industries, appointed by the American Mining Congress, conferred recently with Secretary Hoover. The Secretary referred to the assistance, in reviving American foreign commerce, which mineral producers could give through co-operation with American shipowners, and a sub-committee consisting of T. H. Watkins, representing coal, George S. Davidson, representing oil, and Bulkeley Wells and B. B. Thayer, representing copper, was appointed to join with representatives of other exporting interests in conference with steamship owners looking to plans to assist. This committee will formulate recommendations to be considered by the general committee. Assurance was given the Secretary of the co-operative assistance of the mining industries.

POSITION OF ZINC IMPROVES

There has been improvement in the statistical and trade position of zinc during the past three months, yet it has in no sense been as sensational as New York reports would

lead one to believe. There are in surplus stocks in this country approximately 71,000 tons. This compares with 91,000 tons on the first of July, the highest point ever known, and a normal surplus around 30,000. Recent advices had the surplus drawn down to 40,000 tons and this was 10,000 tons above the normal, according to the 'Boston News Bureau'.

In August and September the visible surplus was reduced 5000 tons in each month. October was a period of relatively brisk business and stocks were cut 10,000 tons, leaving the total at the end of that month at approximately 71,000 tons, and it is not at all improbable that at the end of the current month another cut will have been made. Production in this country is at present running between 14,000 and 14,500 tons of zinc per month, against a normal output of 25,000 to 30,000 tons. There has been a substantial demand from the steel industries and galvanizers, and this improvement in the statistical position is all the more striking when it is remembered that today foreign zinc smelters are able to ship their product to this country and meet domestic competition. Butte & Superior recently advanced to 17¼, up 4 from its recent low, and American Zinc has sold at 11, as compared with low of 8. The preferred sold at 35, a 10-point advance from its low point.

GREENE-CANANEA COMPANY IS SELLING COPPER RAPIDLY; ANACONDA INTERESTS ACQUIRE STOCK

The Greene-Cananea Copper Co. has materially lightened its holdings of unsold copper recently. At the close of last year the company had a considerable tonnage of metal on hand in addition to the 18,400,000 lb. it had pledged with the Copper Export Association in the latter's 400,000,000-lb. pool. Most of the copper it was carrying itself has been sold. Regardless of this lightening of the inventory load, however, it is not the intention of Greene-Cananea officials to resume operations right away. The company is exceptionally well entrenched in liquid assets, having had at the close of last year nearly $7,000,000 over and above all liabilities. This is equivalent to almost $12 per share on the 500,000 shares of Greene outstanding—virtually 50% of the present selling price of the stock. The steadiness of the shares in the last few months, or since the August lows, has been noteworthy. No small amount of the buying has been traceable to interests identified with the Anaconda Copper Co., and while the latter is a holder of record of 59,600 shares of Greene-Cananea, its actual ownership is thought to be very much in excess of this.

TINTIC STANDARD MILL IS GIVING SATISFACTION

The chloridizing-leaching plant of the Tintic Standard Mining Co., east of Eureka, Utah, is treating in the neighborhood of 160 tons daily. It is expected that two more roasting-furnaces, started several weeks ago, will be completed and in operation in December, bringing the total number up to nine and increasing the mill's capacity to a considerable extent.

Some time ago the smelters forced the Standard and other Tintic mines to reduce shipments. This order made a big difference in the output from the East Tintic property, but it is believed that it will be only a short time until the mine is able to place a much larger amount of ore on the market. E. J. Raddatz, the manager, is quoted as saying: "We have been shipping our product twice each month and getting out 50,000 oz. of silver every 30 days. It is quite certain that a large amount of silver, perhaps over 60,000 oz., will be marketed during the present month. I am thoroughly pleased with the milling operations and wish to say that the disappointments in connection with the plant have been of a trifling nature. The mill is sure to be a big factor in the growth and development of the Tintic Standard mine. We are still experimenting on our lead-saving apparatus."

NORTHWEST MINING ASSOCIATION OPPOSES NEW MINING LEGISLATION

The following resolution was passed by the Northwest Mining Association, at a special meeting on November 19, 1921:

Whereas a bill to revise, amend, and codify the laws of the United States, relating to the location of mining claims on the public domain, is now before the 67th Congress and known as H. R. 7736; and

Whereas the purposes and probable effects of this bill, if enacted, have been carefully studied by competent committees of this Association and have been adversely reported upon; and

Whereas the existing Federal Mining Laws are now well and generally understood, as interpreted by the courts in the last 49 years, and have not proved sufficiently defective to require drastic revision, now therefore be it

Resolved, That the Northwest Mining Association, representing mining interests in the States of Montana, Idaho, Washington, and Oregon, at a regular meeting in Spokane, Washington, November 19, 1921, does hereby respectfully protest the passage of this bill on the ground that it is not competent to improve present mining conditions, but that, on the other hand, it would doubtless prove both burdensome and intolerable in several respects and make confusion worse confounded, as shown by the attached analysis which is hereby made a part hereof. And be it further

Resolved, That this Association believes that no legislation should be enacted to further handicap the mining industry at this time, but that it should be permitted to recover from its present depression under the old and well-known statutes.

Also, that copies of this resolution and the analysis of H. R. 7736 be sent to each Senator and Representative of this region and to the chairmen of the Senate and House Committees on Mines and Mining, with an urgent request for their careful consideration.

The undersigned hereby certify that the above is correct:

G. B. DENNIS, President.
F. C. Barley, Secretary.

ARIZONA

Bisbee.—Messrs. Medigovich and Lutich have opened a good-sized body of rich ore on the Wakefield Silver-Gold property in the Hauchuca mountains. The lessees have erected a 5-ton concentrator and are saving 90% of the metal in the high-grade ore. Operations will probably continue through the winter.

Several thousand tons of the best ore known for years in the Bisbee district is reported ready for stoping in the Southwest claims of the Copper Queen Branch. The ground is near the upper end of the limestone and the Southwest workings are said to be close to the quartzite bottom within which no ore has been found. In the same section, around the Glory Hole, were the original workings of the camp, the only point where the copper ore was visible on the surface. Nearly all the slag of the old Copper Queen smelter has been used as flux in the company's smelter at Douglas, incidentally contributing about 5% of copper that had been left by the imperfect smelting operations of pioneer days. The rest is to go to Douglas when the furnaces are again heated. Much of the old dump-site is to be included in the scope of the steam-shovel operations that are to start at Sacramento Hill.

Douglas.—Landowners are making complaint of damage they say is done to crops by the smoke of the Copper Queen and Calumet & Arizona smelters. At a conference held be-

tween company officials and representatives of the landowners there was indication of willingness on the part of both sides to adjust differences without litigation. A similar dispute taken to the courts from the Verde valley near Jerome gave the farmer plaintiffs a verdict of $1 and costs.

Jerome.—The Shannon Copper Co. has discontinued development work on its Yaeger and Gleeson properties. During the course of exploration, 1000 tons of ore assaying 40% copper was mined and is now ready for smelting when operations are resumed.

Katherine.—James F. Collins is in charge of development of the Big Four group, with W. W. Wishon, of Searchlight, as consulting engineer. A development fund of $30,000 is available. The property is near the Gold Chain. The company's main vein is said to sample from $2 to $5 per ton across 40 ft.——The Adams property, a mile from the Gold Chain and on the same vein, has erected a surface plant, moved from near Oatman. At 50 ft., two feet of quartz is said to average $30 in gold.

Kingman.—The Tom Reed company, rather than deplete its high-grade ores, is planning methods for more economical working of the immense quantity of developed ore of medium or low grade. Some miners have been laid-off. There is hope that the mill may be continued at full capacity by taking about 100 tons per day of custom ores, on a basis of $2 per ton cost, with payment for 95% of the gold value and 80% of the silver. The Gold Ore is understood to be contracting for the handling of 50 tons per day, and the United American and Telluride, near-by properties, also have large quantities of available milling ore. Most of the high-grade Tom Reed ore is being taken from the Aztec section, and trammed to the Ben Harrison shaft.

The Oatman United company is developing a 3-ft. vein said to average $20 for a distance of 200 ft. Drilling has shown the presence of ore much deeper than the drift-level at 600 ft.——The United Eastern is reported to have cut its vein 200 ft. from the 850-ft. station by means of a diamond-drill. Development work is to be started soon on the ground lately purchased from the Big Jim Co. On this ground, ore was developed on the 600-ft. level, the deepest working.——A stringer of rich silver ore has been cut in a tunnel intended to develop water for irrigation from flooded workings in the old Silver King mine, 15 miles east of Kingman. Operations were suspended years ago when the vein faulted. Now there is belief that the stringer points the way to a continuation of the main orebody. The new ore assays up to $700 per ton.

CALIFORNIA

Angels Camp.—J. B. Cella, of New York, J. B. Demaria, and Dante Foresti are reported to have purchased a large block of stock in the Triple Lode gold mine. With the money thus secured development of the property will be rushed.

Downieville.—A. T. Hathaway and E. L. Cleveland have taken an option and lease on the Oxford mine near here. The terms of the contract have not been disclosed. The Oxford is owned by a corporation headed by H. H. Meyer and E. L. Case. It is a quartz-gold property and has yielded well at various times.

Etna Mills.—Operations have been resumed at the Cub Bear mine by the Siskiyou Syndicate, and the five-stamp mill formerly operated at the Advance group is being moved to the property. Gold ore of good grade has been opened. The property was closed during the War.——Good ore is reported exposed in the Highland mine, and the management is completing arrangements for a steady output throughout the winter. The Highland has long been a noted producer of high-grade ore.——Rehabilitation of the old Black Bear group is proceeding, and the dump ores are being milled.

Sonora.—The Springfield tunnel has been connected with the old shaft after 12 years of work under the direction of John S. Cademartori. The task of driving the drain-tunnel has cost about $500,000. Almost fabulous gold ore was found in the bottom of the old shaft before the miners were driven out by water. Four large steam-pumps were unable to check the flow, so work was abandoned and the long tunnel was commenced.

Sutter Creek.—Two hundred feet of shaft-sinking at the Central Eureka mine has been completed and timbers are in place. The bottom of the shaft is in greenstone. It is 4194 ft. from the collar of the shaft to the bottom. Some shaft-bulkheads are to be taken out, and the main skip-tracks extended about 200 ft., after which the miners will start to cut the 4100-ft. station and the ore-bins beneath it. Albion S. Howe, superintendent, says that this will be done as rapidly as possible. A new transformer-house has been erected. The new hoist building is nearly completed and work of

Cripple Creek, Colorado, and Vicinity

assembling the hoisting machinery is well advanced. When the ore-bins, skip-tracks, and hoisting machinery are installed, the production of ore on the lowest level of the mine will be begun. The mine now is one of the deepest on the Mother Lode.

COLORADO

Aspen.—The Hurricane Mining Co. operating its own and leased properties extending from the Hurricane and Climax to the north and to Castle Creek, south, has opened a new vein on the Etcetera claim. The 'paystreak', two feet wide, samples 5 to 15% lead and 10 oz. silver; it is gaining in width and richness as the drift is extended. The breast of the tunnel is nearing the point where the orebody exposed in the upper tunnel should be cut. The new tunnel will drain the upper workings and afford 150 ft. of backs.

Central City.—The Comet tunnel, near the Rara Avis mine, has been leased and bonded to Illinois and Nebraska operators, who have opened a 6-in. streak of ore sampling $45 per ton.

Creede.—Lessees on the New York have opened a big body

of mill-ore between the 9th and 10th levels and have commenced shipments. The Manitoba is producing good smelting ore and the owners and operators are making weekly shipments to the Leadville smelter regularly.

A shipment of $50 ore was made to the A. V. smelter at Leadville by lessees on the Ethel mine recently.——The Wabash M. & P. Co. is shipping regular weekly 5-car consignments of ore to Leadville; with a lower freight-rate production and shipments would be increased.

Cripple Creek.—The Cresson company continues heavy production; 8 to 18 cars averaging 35 tons to the car are shipped daily. This ore averages $12 to $15 as broken. The shares of the company made a big advance on the Colorado Springs Exchange and New York Curb market recently.

Increased tonnage is the order of the day at the Portland. The tonnage to the Independence mill has been increased 50% while the treatment cost has been lowered. Perry O. Harrison has succeeded G. M. Taylor as manager. Thomas B. Crowe, mill manager for many years, has resigned and left the service of the company. Work also has been resumed at the Independence where the haulage tunnel is being extended 750 ft. to make possible the more economical handling of ores from the Battle Mountain mines.

Ouray.—Oil men of Colorado and Wyoming, with some capital, have formed the Welch-Worland Mines Syndicate and taken over the mines and milling plant originally owned by the Wanakah Mining Co., and more recently by the Union Mining & Milling Co., under a bond and lease covering a nine-year term. The property is credited with producing in excess of $1,000,000 in gold, silver, and copper ore. Modern machinery has been ordered to re-equip the mill and mine, and development is planned.——Lessees on the No. 1 and No. 2 levels of the Barstow mine are producing. Shipments will be made soon.——A new trail is under construction to the Hidden Treasure and shipments of three cars weekly will be maintained during the winter.

Silverton.—The Little Nation Mining Co. has increased its operating force and will continue work through the winter. A raise has been started to connect the Royal Charter and Little Nation levels proving the continuity of the orebody. Good mill-ore is opened for the entire distance of a 1000-ft. drift. The ore-streak is 12 to 18 in. wide carrying both lead and silver. The Royal Charter level, about 250 ft. below the Little Nation level, has been extended 1200 ft.; the continuation of the several ore-shoots from the level above has been proved.

IDAHO

Coeur d'Alene.—According to reports the Day interests intend to resume the first of the year the operation of their mines in this region. These include both the Hercules and the Tamarack & Custer, two of the largest lead-silver mines in the United States.——Resumption of operations by the Nabob Consolidated company is predicted by Charles H. Fisher, recently elected as one of the new directors of the company. A recent court order gives Spokane and Coeur d'Alene men control of the property and they have elected a new board including E. J. Lippert, Charles H. Fisher, J. E. Codd, and A. W. Codd, all of Spokane. A. E. McCarthy, the fifth director, is a resident of Coeur d'Alene.——The new cross-cut on the Jim Blaine group has been driven 220 ft., according to reports at hand. It has penetrated a blind vein 21 ft. without reaching the wall. The vein is reported to contain 3% lead, and 2 oz. silver per ton. The property consists of 27 claims opposite the Nabob mill on Pine creek. Additional men have been employed.

MICHIGAN

Houghton.—Sinking will be resumed in the New Baltic shaft of Arcadian Consolidated early in December. It has been virtually decided to continue the shaft, now bottomed at the 942-ft. level, to a depth of 1060 ft., corresponding with the 1050-ft. level of the New Arcadian shaft which is bottomed at 1850 ft. It is expected the objective will have been reached by February 1. A drift southward to connect with the New Arcadian shaft then will be driven, paralleling the south drift from the 9th level. It is primarily to drive this new drift that the New Baltic shaft will be lowered for it will provide the means and opportunity for a closer checking of the ground and furnish the desired geological information necessary to an intelligent opening of the territory between the two shafts. An additional small force of men will be employed for the sinking operations. The company is well supplied with machinery and practically all material for the performing of this work. It has adequate hoisting facilities, drills, rails, piping, and pumps, lacking only the necessary timber. The vein is close to the shaft and the shaft will go down just under the lode.

Throughout the years that copper flourished and the Lake district prospered accordingly, having no thought of any possible setbacks, little or nothing was heard of diversified industries here. But this subject has been foremost in the copper country's mind since the depression in the copper market forced the majority of the mines to close. There appears to be a widespread belief that copper could be fabricated here, and there is a marked disposition to look to the mining companies to get into the manufacturing field. But it is apparent the companies are not very keen about it and it would appear they would rather continue as they have been doing, mining copper and taking their chances in the open market. Once operations are resumed, however, it is unlikely any great surplus of metal ever will be accumulated again.

With the return of normal conditions in the metal market Wolverine no doubt will be encouraged to explore amygdaloid formations found several years ago on the 13th level, west, and the 22nd level, east. The showing in these veins for the short distance they were drifted into warrants further investigation. Wolverine's yield continues at 14.5 lb. per ton, refined. Pillar mining is being conducted on the 35th, 36th, and 37th levels of No. 4 shaft, while regular mining, such as widening of stopes and drifts to the hanging and foot-walls, also is under way in the lower levels.

It is estimated there are 12,000,000 tons of sand in the Tamarack conglomerate tailing in Torch lake, assaying 12½ lb. of copper to the ton. Calumet & Hecla plans to complete the reclamation plant there next summer and the recovery of this metal then will begin. While the deposit is not as extensive or as rich as that of Calumet & Hecla proper, the copper can be recovered at low cost and the plant investment will yield a large return. The Calumet & Hecla deposit originally contained 40,000,000 tons, running as high as 14½ lb. of copper to the ton. In 1920, the Calumet & Hecla tailing assayed 13.1 lb. per ton and of this amount 10¼ lb. was recovered. A total of 14,138,240 lb. was produced, at a cost of 6.6c. per pound, exclusive of smelting and selling expense. This cost was high on account of the abnormal price of coal and high cost of labor and supplies. It compares with a normal cost of 4½ to 5c. per pound. In the few years the Calumet & Hecla reclamation plant has operated it has recovered 48,537,488 lb. of copper. It is estimated the remaining sand carries over 450,000,000 lb. of metal. There was a time when the idea of recovering any copper from the sand was scoffed at, but the results have fully justified the hopes of the company.

MONTANA

Butte.—The North Butte company has approximately 14,000,000 lb. of unsold copper on hand but the directors instructed the selling agents recently to suspend sales until further notice. Development of the Edith May vein on the

3400- and 3600-ft. levels from the Granite Mountain shaft is progressing satisfactorily.——The Colorado mine of the Davis-Daly company has been shut-down, but the pumps are in operation and foremen and other officials are being retained on the payroll. The company's Hibernia mine continues to operate regularly.

Wise River.—Operations have been commenced at the Boston-Montana mill, following the completion of connection with the main electric-transmission line of the Montana Power Co. Electric energy is now available for the treatment of 750 tons of ore per day, as planned for the initial unit of the mill. The plant is going through the 'breaking-in' process, and regular production should start soon.

NEVADA

Candelaria.—Plans for the erection of a 300-ton cyanide plant for the Candelaria Mines Co. are complete. The mill will be built near the portal of No. 11 tunnel below the railroad grade. The Candelaria company owns the old Ar-Hill mine in the Railroad Springs district. The vein is 20 ft. wide and can be mined to yield some shipping ore.

Rochester.—The Rochester Silver Corporation, during the first half of November, milled 155 tons of ore per day, having a gold content of 0.137 oz. and 12.23 oz. silver. During October 92.8% of the gold and 84.7% of the silver in the ore was recovered in the company's cyanide plant.

Tonopah.—The Gold Zone Co. has confirmed reports of important developments on the 500-ft. level. The vein was first entered early in October, 16 ft. from the boundary line of the Tonopah Divide, and is said to have been proved for over 200 ft. by raises from the 500-ft. level. Shipments to Tonopah mills have begun and work has been started on the 300-ft. level to tap the vein at this point.

NEW MEXICO

Las Cruces.—Gold has been discovered recently on the south-west slope of the San Mateo mountains, 115 miles north-west of here, according to the statement of A. H. Reynolds, of El Paso, made in the 'El Paso Herald'. He is quoted as saying: "It is a camp that only mining men or prospectors with $500 to $1500, which they can afford to spend, should investigate. It is no place to start a rush or a boom by a lot of poor people expecting to make money quickly and easily, for it is, of necessity, not that kind of a camp. With that reservation and caution, I do not hesitate to say that in my 40 years of mining experience, during which I have seen a good many gold camps, I have never seen in a new camp a larger or better showing of gold. I have about five pounds of specimens of the newly discovered ore showing free gold. It is from a stringer 3 ft. wide, at the bottom of a 20-ft. shaft in a 30-ft. lode that all pans gold. Conditions of the locality of the new camp are favorable to economic operation of mines and mills. The nearest stores and postoffices to the camp are at Monticello, 6 miles, and Cuchillo, 12 miles. Both are in Socorro county. The Elephant Butte irrigation dam and lake are in sight of the camp. There is plenty of wood and mountain water. Good roads lead to the camp."

Hauling Mine-Timbers in the Coeur d'Alene Region

gentum and Mount Diablo mines and the Lucky Hill property that is on the Mount Diablo vein; $610,000 of assured ore that will assay $15 mostly in silver constitutes the ore-reserve to date.

Carson City.—A through joint rate on ore from Plumas county, California, to the Thompson smelter near Wabuska has been ordered by the Interstate Commerce Commission. Heretofore the rate charged was a combination of local rates over three roads; the consequence was that the 600-mile haul from the Engels mine to the smelters in Utah was cheaper than the 210-mile haul to Wabuska. According to the new schedule the freight from Plumas county to Wabuska will vary from $2.83 to $5.36 for ore valued at from $20 to $100. This compares with a rate of $5.35 per ton for $100 ore to the Utah smelters.

Ely.—Following an examination by Raymond G. Guyer and S. M. Soupcoff the Boston & Ely company has increased its working force. The shaft has reached a depth of 100 ft. and cross-cuts will now be driven east and west in the limonite. It is reported that 20,000 tons of 6% copper ore has been developed.

Goldfield.—It is stated that the Goldfield Development Co. has entered an ore-shoot at a depth of 300 ft. in the Gold

UTAH

Big Cottonwood Canyon.—Bonanza ore has been found in the Woodlawn mine. At first it was but 3 in. thick; it is

now 6 in., and W. J. Lawrence, manager, believes that the streak will prove to be a lead to an ore-shoot in the lime stratum which the lowest level in the mine—the 700—is approaching. Two tons of ore has been shipped, which gave smelter returns of $2.83 in gold, 405.1 oz. in silver, 2.09% copper, 7.35% lead, and 9% iron.

Eureka.—Directors of the Eureka Hill Mining Co. have declared a dividend of $1 per share, which will call for the disbursement of $10,000. This is the first dividend to be paid in two years. The Eureka Hill is a unique property. It has been a steady producer for 51 years, has never levied an assessment, and has paid more than $2,250,000 in dividends. The 10,000 shares of stock are owned by four people, only one of whom, Moylan C. Fox, resides in Utah. The company owns 29 acres in the heart of this district, has been opened by 35 miles of workings, and is one of the richest mines ever discovered in Utah. During recent years the revenue has been derived from royalties received from lessees and money received from the sale of water of which the company has an excessive supply.

Engineers for the Chief Consolidated Mining Co. are making an examination and survey of the Eureka Lily property, preparatory to beginning development work. Plans for development at the Grand Central mine are being made by Paul Hillsdale, who recently took an option on the property. While the mine is being re-surveyed and mapped, Hillsdale will continue to permit lessees to work. The scale of royalties will be the same as under the old management; from 25% on the lower-grade ores, up to 75% on ore carrying $200 per ton and over. W. J. Coombs, who has been connected with the Grand Central for many years, will act as lease-boss.

F. A. Hebbard, a geologist formerly connected with a large oil company in California, has taken a lease on the talc deposits of the Dragon mine. Within a short time Mr. Hebbard expects to be shipping 500 tons of fuller's earth per month. This tonnage has been contracted by one of the large oil companies on the Pacific coast. Fuller's earth, used in the refining of mineral oils, is said to be worth $20 to $25 per ton, f.o.b. Pacific coast points. Hebbard states that the oil industry last year consumed 300,000 tons of the material, whereas in 1890 the consumption was but 20,000 tons. The local product is said to be of a higher grade than the Florida deposits, which heretofore have been the main source of supply in the United States.

Ore shipments from this district for the week ending November 19 totaled 167 carloads. The Chief Consolidated shipped 46 cars; Tintic Standard, 46; Victoria, 17; Dragon, 14; Iron Blossom, 10; Eagle & Blue Bell, 8; Swansea, 4; Centennial-Eureka, 5; Grand Central, 3; Gemini, 2; Empire Mines, 2; Bullion-Beck, 2; Mammoth, 1; Sunbeam, 1; and Eureka Mines, 1. Shipments the previous week totaled 165 carloads.

Officials of the North Standard Mining Co. are taking a keen interest in the sinking of the Water Lily shaft by the Chief Consolidated Mining Co. This shaft is but 600 ft. from the south boundary of the North Standard's property, and the results obtained by the Chief Consolidated in the way of development work in that vicinity will have a bearing on future exploratory work in the North Standard. Recent developments on the 500-ft. and 1100-ft. levels have been encouraging.

Park City.—Shipments of ore from this district for the week ending November 19 totaled 2279 tons, as against 1962 tons the preceding week. The Silver King Coalition shipped 948 tons; Judge allied companies, 943; Ontario, 388.

Recent development work at the Park-Utah property has been of such an encouraging nature that numerous claims have been taken up by local residents and mining companies in the territory to the east of the Ontario dike, a part of the district that has never been thoroughly explored.

Salt Lake City.—The slogan 'Buy Something Made of Copper' has been featured extensively in Utah recently. The Salt Lake Commercial Club adopted a resolution, calling upon all of its members to give the fullest publicity to the slogan, as well as to practice it. The moving-picture theatres have joined in the movement, using slides reading: "Buy Something Made of Copper and Help to Re-open Utah's Copper Mines".

In the case of Nikolas Pappas v. the American Smelting & Refining Co. for alleged damage to the plaintiff's bakery shop and home at Murray, caused by smoke from the slag dump, a verdict in favor of the smelting company was rendered on November 23. This is the first smelter smoke case to be heard in Utah in a number of months.

The Bingham & Garfield Railway Co. and the Salt Lake Route have been given permission by the Public Utilities Commission to discontinue the passenger train operated between Salt Lake City and Bingham. The railway companies submitted a statement to the Commission that they were losing $1000 per month in operating this train. Since the closing down of the Utah Consolidated, Utah Apex, and Utah Copper companies last spring, Bingham has lost much of its population. It is stated that the present population of the camp is about 2500, as against 8000 in 1918. An auto-bus service is operated between Salt Lake City and Bingham, and this line gets practically all of the passenger and express business.

A recent compilation of figures submitted by the State Board of Equalization reveals interesting information concerning metal mining in Utah during 1920. The total operating costs of the metal-mining companies that year were $34,893,412. Of this amount, the cost of mining and development, including labor, powder, timber, drill-steel, power, etc., was $13,324,629; milling and smelting expense, $17,559,727; freight on ore and concentrates, $2,850,657; while construction expenditures at mines, mills, and smelters totaled $1,158,399. Another interesting feature of the report is that the metal mines of the State last year supplied 45% of the total tonnage of intra-state business handled by the railways. Mining is the most important industry in Utah; when the mines prosper, the State prospers.

WASHINGTON

Spokane.—Adolf Kunz, of Chicago, president of the American Minerals Production Co., which operates large magnesite properties at Valley, 50 miles north of here, had the following to say regarding the tariff on magnesite during a recent visit:

"The tariff bill, which would give a tariff of $15 a ton on magnesite, has passed the House and is now being considered by the Finance Committee of the Senate. We hope for and should receive a favorable report. So far as we know all of the Western Senators and Representatives are in favor of such a tariff. We do not ask that foreign magnesite be shut-out, but we do ask for a tariff that will enable us to compete, which we can not now do. This country needed and used our magnesite during the War, while the Austrian magnesite, now being shipped in, was used to make bullets for use against us. We do not believe that this country should give all its trade to Austria.

"We have done much experimenting with plastic magnesite for use in building operations, as stucco, for flooring, and other similar uses. We have met with a great deal of success and can deliver a uniform product, lack of which used to be the main objection to magnesite. We are just completing two new kilns and are shipping some magnesite for building purposes. With the tariff in effect so that we have a chance at the refractories business we are in position to ship larger quantities and employ more men."

BRITISH COLUMBIA

Alice Arm.—The Dolly Varden mine was shut-down on November 7 for an indefinite period. The Taylor Mining Co. has not repaired the wash-outs and damage to the foundations of some of the bridges, caused by the floods of last month, and consequently it is impossible to take supplies to the property or bring ore from it. It is understood that the Taylor company has been trying to get additional money into the concern, to finance much-needed repairs, development of the mine, and the erection of a concentrating plant. Recently J. A. Bancroft, assistant manager of the Granby Consolidated company, examined the mine, making the trip on a hand-car with members of the Taylor company and others; on the return journey the car left the tracks and all were precipitated into the Kitsault river. Fortunately, none was any the worse for the adventure. The cessation of the operation of the railway is a serious handicap to other mines and prospects at the head of the Kitsault river.

Cranbrook.—The Gamble Mining Co. held its annual general meeting on November 9, when the manager stated that at the time of the shut-down, necessitated by lack of water, good pay-dirt had been found; now, with ample water assured, the outlook for a profitable season next year is bright. John Taylor was elected president and general manager.

Hudson's Hope.—Detroit capitalists have secured claims along 20 miles of the upper Peace river, where, it is said, some rich ground has been proved. The owners propose to put a dredge on the river next spring.

Penticton.—A find of rich silver ore has been made at the Sally mine, particulars and extent of which, however, are not yet to hand. The Sally, which is operated by the Wallace Mountain Mines, Ltd., has been producing ore running between 300 and 400 oz. silver per ton; last year it shipped ore to the value of $80,000 to Trail.

Stewart.—W. R. Tonkin, president and general manager for the Fish Creek Mining Co., has gone to Seattle for the winter, and expects to arrange for the erection of a concentrating and compressor plant at the mine in the spring. Tonkin reports that rich ore has been struck on the Olympia claim in a raise that was started to connect No. 1 and No. 2 tunnels. It is believed that the shoot is the same as that found on the surface and in the No. 2 tunnel. On the surface the ore-shoot was uncovered for a length of 600 ft.; it averaged 5 ft. in width, and one-third of it was shipping ore, ranging from $300 to $400 per ton, while the remainder ran from $30 to $40 per ton. Some 15 tons of the shipping ore has been sacked, and will be sent to the smelter as soon as the condition of the snow allows sledding.——William Fraser reports the discovery of a new 8-ft. vein, well impregnated with gray copper, on his property, in the Marmot River district.

Vancouver.—A cable from London was received at the Granby Consolidated M. S. & P. Co. office on November 17, announcing that the Privy Council had rendered decisions in favor of the company in all the four cases that had been tried. These decisions vest the Cassidy colliery securely with the Granby company. The decisions are of considerable importance, apart from the fact that the Granby has expended some two and a quarter million dollars in the purchase and equipment of the colliery.

MEXICO

El Tigre.—John Hohstadt is doing a large amount of dedevolpment work on his claims in the Pilares de Teres district north of here. William Hudson, the contractor, is driving a tunnel north of La Bota canyon in the hope of striking the Carabinas vein which has been one of the best producers in this district. A vein 10 ft. wide of lead-zinc ore carrying 35 oz. silver was found on the southern part of Hohstadt's ground, but no attempt has been made to mine this as yet.

Camp at the Dolly Varden Mine

George S. Solomon of Bisbee and partners have taken up a group of claims reaching from the Santa Isabel north of La Bota conyon, to the Santa Maria claim of the El Tigre Co. The claims include La Bota, La Mina Suerte, and La Suerte Segunde. Development work will be started immediately on La Bota.

Moctezuma.—The Progreso Silver Mining Co. has been running one shift continuously for several months in its cyanide plant, on ore from the dumps. Approximately 10,000 oz. of silver bullion containing some gold is produced per month.

ONTARIO

Cobalt.—The question of operating the Temiskaming mine under a leasing system is under consideration. The matter was discussed in official circles on former occasions, but the possibilities of the company operating the property profitably on its own account discouraged the scheme. Now, however, with the mine closed down, it is believed the underground workings could be divided into sections of limited size and

leased to good advantage on a royalty basis. It has just been learned that a group of Cobalt miners are preparing a tender to participate in leases on the mine provided the directors consider the plan favorably.

The original property of the La Rose Consolidated, which was flooded recently by a cave-in of rock, permitting the water flowing from Cobalt lake to enter the workings, will probably never be unwatered. The mine is flooded completely, and a considerable tonnage of low-grade ore as well as a limited amount of high-grade has probably been lost. The company continues to operate its Violet, University, and Princess properties with success, and is producing from 1000 to 1500 oz. of silver daily.

Kirkland Lake.—The Lake Shore during October established a new high record by the treatment of 2015 tons of ore with a recovery of $51,302, averaging $25.46 per ton. The mill ran 97.98% of possible running time.

A special meeting of the shareholders of the King Kirkland will be held on November 28 to consider proposals to increase the capitalization from 2,500,000 to 5,000,000 shares and to purchase the Ferguson claims in the Larder Lake district comprising 80 acres for 45,000 shares.

Porcupine.—The directors of the McIntyre have decided to proceed immediately with the installation of additional equipment, which it is calculated will increase the capacity of the mill from 550 tons daily to 800 tons. Action has been delayed for some time on account of the occurrence of carbon in the ore from the lower levels rendering it difficult of treatment by the ordinary methods, but this obstacle has now been satisfactorily overcome. The new equipment will be a separate unit of 250 tons capacity designed for the treatment of the carbonaceous ores by a special process of oil-flotation. The work will commence immediately so as to have the new unit ready for operation in March. The main shaft has now reached a depth of 1875 ft., where a station is being cut preparatory to opening levels at 1625, 1750, and 1875 feet.

At the property of the Union Mining Corporation, about 30 miles south-west of the producing area of the camp, a shaft is down 300 ft. and lateral work is being done at the 150- and 300-ft. levels. Diamond-drilling will be undertaken to explore the property at a lower depth.

The Nipissing, of Cobalt, has resumed diamond-drilling on the Rochester immediately adjoining the Hollinger. Assay-returns from previous drilling are understood to have been favorable.

YUKON TERRITORY

Dawson.—George Black, one of the candidates for Yukon in the coming Federal election, has just returned from a trip to Mayo and Keno Hill; he reports great activity at the latter place. The Alaska Treadwell interests are sinking two 300-ft. shafts, which are to be connected by four levels. The Yukon Gold Co. has opened a new lode, the ore in which is running from 300 to 500 oz. in silver. A rich strike has been made on Galena hill, about a mile from Keno Hill, and sixty new claims have been staked. Altogether 1500 claims have been staked on Keno hill. About 600 men are employed at the camp, and the hauling of ore to Mayo Landing has commenced. It is expected that fully 6000 tons will be shipped from there next spring. A telephone line connecting Keno Hill with Mayo has just been completed. ——There has been a small stampede from Dawson and adjoining creeks to Allgold creek, a tributary of Flat creek. The creek has been prospected before, but most of the leases have been abandoned and have reverted to the Crown. Duncan Michie, who has been prospecting on Allgold creek for seven years, recently struck good ground, much of which, it is stated, is running up to $15 per pan. The gold is 'nuggety' and coarse. It was this discovery that caused the stampede.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

George H. Garrey is at Tonopah.

C. K. Leith was in New York last week.

Norman Stines spent Thanksgiving at Seattle.

Charles Janin is on his way from San Francisco to New York.

Frank L. Sizer has returned to San Francisco from Elko, Nevada.

A. W. Fahrenwald has returned to Moscow, Idaho, from Nevada.

Arthur Notman has moved from New York City to Bisbee, Arizona.

Etienne A. Ritter has moved from Oatman, Arizona, to Denver, Colorado.

A. G. McGregor has been elected president of the Bisbee Chamber of Commerce.

Reginald E. Hore has been appointed editor of the 'Canadian Mining Journal'.

J. P. Benson, recently at San Juan de Lima, in Nicaragua, is now at Berkeley, California.

Norman D. Lindsley has moved from Dos Cabezas, Arizona, to Lakeside, Washington.

A. Law Voge, chemical engineer, of New York City, has been in Nevada and is now here.

Persifor G. Spilsbury, who now resides at Phoenix, has been recently at Clifton, Arizona.

Arthur R. Weigall, of the Tui Mi Chung company, at Seoul, Korea, is in San Francisco.

Erick K. Craig, recently at Medellin, Colombia, South America, is at Piedmont, California.

J. B. Tyrrell has been examining a group of mines in the Cariboo district of British Columbia.

J. E. White, of Santa Barbara, has been examining a group of claims at Randsburg, California.

William Forstner has returned from examining the old Niagara mine in Shasta county, California.

F. E. Dodge is vice-president and manager for the Protexol Corporation, Kenilworth, New Jersey.

Harry R. Bischoff has left the Coeur d'Alene region and is temporarily residing at St. Paul, Minnesota.

Walter J. Eaton has been appointed superintendent of the Smuggler-Union mine, at Telluride, Colorado.

C. T. Durell, who is now in the Natural Resources Division of the Treasury department, spent Thanksgiving in San Francisco.

Robert S. Lewis, Professor of Mining, is now at the University of Utah, in Salt Lake City, having returned from Los Angeles.

William J. Loring has returned from a week's trip through southern California on business in connection with his various enterprises.

Charles Bocking, manager for the Butte & Superior Mining Co., has returned to Butte after an absence of several weeks in New York.

C. P. Nichols, son of **Horace G. Nichols,** has graduated from the Royal School of Mines, London, and has joined the staff of the Burma Corporation at Namtu.

T. Nishikawa, of the Imperial University at Tokyo, has been visiting mining districts in Utah, accompanied by a party of friends. He will sail from San Francisco on the 'Taiyo Maru' on December 5 for Yokohama.

THE METAL MARKET

METAL PRICES

San Francisco, November 29.

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.50
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$80
Platinum, 10% iridium, per ounce	$92
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

November 28.—Copper is active and higher. Lead is quiet and firm. Zinc is quiet and steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Nov. 22	67.75	38.00
" 23	68.25	38.50
" 24 Holiday		
" 25	67.87	37.62
" 26	66.25	37.37
" 27 Sunday		
" 28	67.62	37.75

Average week ending	Cents	Pence
Oct. 17	72.97	42.57
" 24	70.64	40.52
" 31	70.04	40.25
Nov. 7	69.46	39.93
" 14	67.28	38.85
" 21	68.54	38.83
" 28	67.55	37.85

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	....
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Nov. 22	13.25
" 23	13.37
" 24 Holiday	
" 25	13.37
" 26	13.37
" 27 Sunday	
" 28	13.37

Average week ending	
Oct. 17	12.80
" 24	12.69
" 31	12.68
Nov. 7	12.75
" 14	12.88
" 21	13.19
" 28	13.35

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	....
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Nov. 22	4.70
" 23	4.70
" 24 Holiday	
" 25	4.70
" 26	4.70
" 27 Sunday	
" 28	4.70

Average week ending	
Oct. 17	4.70
" 24	4.70
" 31	4.70
Nov. 7	4.70
" 14	4.70
" 21	4.70
" 28	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	....
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	....
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date	
Nov. 22	5.15
" 23	5.15
" 24 Holiday	
" 25	5.12
" 26	5.12
" 27 Sunday	
" 28	5.15

Average week ending	
Oct. 17	5.12
" 24	5.14
" 31	5.07
Nov. 7	5.18
" 14	5.23
" 21	5.18
" 28	5.14

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	....
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	
Nov. 1	42.00
" 7	40.00
Nov. 15	40.00
" 22	40.00
" 29	40.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

RAILROAD BONDS ADVANCE STEADILY

After a steady advance, beginning in mid-summer this year, the bond market suddenly developed a most sensational upward movement on news of the re-discount rate of the New York Reserve Bank from 5 to 4½% some weeks ago. Prices jumped between transactions and bond after bond established a new high for 1921. Volume of bond trading on the New York Exchange rose to $20,000,000 per day. The reaction from this move has been but slight and the list as a whole has continued to move up in an orderly manner. The average price of 40 representative bonds now stands at 82.86, or higher than at any time since the fall of 1918. Bond dealers report the market comparatively bare of bonds and the demand unabated. Attractive new issues are being quickly over-subscribed and sell immediately at a premium. The basis of the new offerings shows a decided easing tendency.

Governor Harding of the Federal Reserve Board finds financial conditions growing better, with rapid accumulation of money in banks. He predicts great industrial impetus all over the world if the Armament Conference should result in material reduction of naval and military expenses, as this will reduce taxes and release for other uses large sums now spent on war materials.

Conspicuous in the current bond advance are the old-time railroad issues, many of which are now selling at the highest prices for 1921. While the advance in some cases has already run into two figures, they have not yet recovered half of the ground lost from the 1917 highs, as brought out in the appended table:

	Current price	Advance from 1921 low	Yield, %	1917 high
Atchison, Topeka & Santa Fe 4s, '95	83⅛	9⅝	4.85	97
Atlantic Coast Line 4s, '52	83	9½	5.10	96⅜
Baltimore & Ohio 4s, '48	77	12½	5.68	94⅜
Central of New Jersey 5s, '87	102½	10⅜	4.87	120½
Chicago, Burlington & Quincy 4s, '58	83½	8¾	4.98	97⅛
Chicago & Northwestern 4s, '87	80⅛	8⅝	5.03	98⅛
Illinois Central 4s, '51	85	3½	4.97	99¾
Louisville & Nashville uni 4s, '40	87½	9¼	4.97	97¾
New York Central 3½s, '97	72	9½	4.89	86⅞
Norfolk & Western con 4s, '96	82¾	8⅞	4.87	97⅛
Northern Pacific prior 4s, '97	82⅜	9⅜	4.88	96¾
Southern Pacific coll 4s, '49	80	13⅜	5.38	88
Union Pacific 1st 4s, '47	86½	8½	4.92	100

MONEY AND EXCHANGE

Foreign quotations on November 29 are as follows:

Sterling, dollars:	Cable	3.99¼
	Demand	3.99¾
Franc, cents:	Cable	7.00
	Demand	7.02
Lira, cents:	Demand	4.12
Mark, cents:		0.43

Eastern Metal Market

New York, November 23.

Activity has developed in the market for tin; a steady business is being done in copper at advancing prices, with the other metals quiet and steady to easy.

Copper grows stronger almost every day. Buying is satisfactory and values have risen.

The Straits tin market has experienced some of the most active days in many months and prices are advancing.

Lead is in quiet demand; prices are steady to firm.

The zinc market is exceedingly dull and values have eased slightly.

Antimony has declined.

IRON AND STEEL

The effort at Washington to link up the steel-rail price with the question of freight-rates for iron and steel may postpone for some time the relief all industry has looked for from lower transportation costs, says 'The Iron Age'. On Tuesday railroad freight executives at a separate meeting in New York decided to continue to March 31 the 28% reduction on iron-ore rates which was to expire December 31. At the same time they declined to grant reductions asked for on coal, coke, limestone, and other raw materials.

The reduction of inventory limits buying by manufacturing consumers of steel, but does not check railroad-car programs which call for 1922 deliveries. At Chicago the 7000 cars let in the past three weeks, the 13,000 now up for bids, and the 8000 for which inquiries will soon come out represent 280,000 tons of steel.

With composite price of seven rolled steel products at 2.1c. per pound, about 88.5% or all but 0.415c. of the projection of the war peak above the ten-year pre-war average has been removed.

COPPER

Strength develops constantly and the market in general is appreciably higher and firmer than a week ago. Buying and inquiry are good from all sources, both foreign and domestic. The electrolytic copper market is strong and active with the major business including first quarter delivery. For this year's delivery the minimum is now 13.50c., delivered, or 13.25c., New York, with nothing less than 13.75c., delivered, for January and first quarter. Sales to England, France, and Germany, particularly the two former, are reported as good at 13.75c. f.a.s. Some producers are not quoting for this year's delivery and some are out of the market even for early next year. Lake copper is quoted at 13.37½ to 13.50c., delivered.

TIN

The most sensational market in Straits tin in many months has been recorded. In fact one large importer characterized the buying of last week, Wednesday to Saturday, as reminiscent of the 'old time' activity. When it is stated that total sales on those days are conservatively estimated to have amounted to close to 2000 tons, its importance can be realized. On Monday and Tuesday of this week the market has been quiet but strong, with spot Straits quoted at 29.62½c., New York. The London market is strong also with spot standard quoted at £161 10s., future standard at £163 5s., and spot Straits at £162. Strength in sterling exchange is also a factor. Arrivals thus far this month have been 2355 tons with 2800 tons reported afloat.

LEAD

The market is without feature but continues to be characterized by a steady quiet demand at firm prices. In fact consumption and production seem to be pretty evenly balanced. The quotation of the American Smelting & Refining Co. is unchanged at 4.70c., New York and St. Louis, while in the outside market there are sellers at 4.70 to 4.75c., New York, or 4.35c., St. Louis, all for early or 30-day delivery. Reports from England indicate a scarcity of the metal there and higher prices.

ZINC

The market for prime Western is exceedingly quiet and slightly easier. Galvanizers and other consumers have apparently bought to cover their immediate needs and perhaps those for this year. At any rate business is small and as a consequence values are easier, there being one or two sellers willing to take the business offered. Prime Western for this year's delivery is quoted at 4.65 to 4.70c., St. Louis, or 5.15 to 5.20c., New York, but the amount available is not large. Most producers are either well sold into November or are holding back in the confidence that higher prices are in store.

ANTIMONY

Wholesale lots for early delivery are now obtainable at lower than recent prices being quoted at 4.50c., New York, duty paid, for wholesale lots for December delivery, with prompt at 4.55c. and jobbing lots at about ¼c. higher.

ALUMINUM

Virgin metal, 98 to 99% pure, continues to be quoted by the leading interest at 24.50c., f.o.b. plant, in wholesale lots for early delivery, but it is believed that importers' prices for the same grade at 17 to 18c., New York, duty paid, are being met by the producer referred to. Demand, however, is not heavy.

ORES

Tungsten: There is nothing fresh to report. The market is still inactive and prices are nominal at $2.50 per unit upward, depending on the quality, tonnage, and delivery.

Molybdenum: There is no activity and nominal quotations prevail at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: Absolute lack of demand characterizes this market and quotations are nominal at 20c. per unit, Atlantic ports, for high-grade foreign ore. Imports in October were heavy at 36,760 gross tons, being the total for the 10 months of the year to 377,834 tons against 467,772 tons to November 1, 1920.

Chrome: No change in conditions is ascertainable. Quotations continue nominal at $20 to $26 per net ton, c.i.f. Atlantic seaboard, for foreign ores of standard quality.

FERRO-ALLOYS

Ferro-manganese: Sales of small lots of British and domestic alloy are reported at a basis of $58.35, seaboard, but demand is generally very light. Imports for October were 1943 gross tons, which make the total to November 1 only 8548 tons as compared with 46,739 tons on November 1, 1920. Exports in October were only 10 tons or 318 tons to November 1, this year, and 2170 tons to November 1, 1920.

Spiegeleisen: Demand is confined to small lots for early delivery at the prevailing quotations of $25 to $26 per ton, furnace, for the higher grade.

Ferro-tungsten: In an inactive market quotations continue nominal at 40 to 45c. per pound of contained tungsten in the domestic alloy and at 50c., duty paid, seaboard, for the foreign.

Ferro-silicon: The 50% alloy is quiet and steady at $60 per ton, delivered, the cheaper lots having been absorbed, it is believed. Sales are confined to a few small lots.

Ferro-chromium: Demand is insignificant at prevailing quotations of 10 to 14c. per pound of contained chromium, delivered, in standard 4 to 6 or 6 to 8% carbon alloy.

Current Prices of Commodities

The figures given on this page represent the regular current price, at the time of our going to press, to industrial buyers of standard commodities in small wholesale lots on San Francisco Bay. They should not be construed as being quotations nor as being either the lowest or the highest price; they are given rather as a guide by which to follow the trend of the market or to estimate the approximate cost of materials and supplies.

CHEMICALS AND ASSAYERS' SUPPLIES

Acid, sulphuric, com'l 66°, in drums, per 100 lb	1.25 to 1.50
" " " " " carboys "	2.25 to 2.75
" " C. P., 9-lb. bottles, in barrels, per pound	0.23½
" " " bulk, in carboys, per pound	0.18½
" muriatic, com'l, in carboys, per 100 lb	2.75 to 3.25
" " C. P., 6-lb. bottles, in barrels, per pound	0.28½
" " " bulk, in carboys, per pound	0.22½
" nitric, com'l, in carboys, per 100 lb	7.75 to 8.75
" " C. P., 7-lb. bottles, in barrels, per pound	0.38
" " " bulk, in carboys, per pound	0.27¾
Argols, ground, in barrels, per pound	0.14
Borax, cryst. and conc., bags, per 100 lb	5.25 to 6.00
" powdered, in barrels "	5.50 to 6.50
" glass, ground, 30 mesh, cases, tin lined, per 100 lb.	16.50 to 17.50
Bone ash, 60 to 80 mesh, in barrels, per 100 lb	8.50
Cyanide, sodium, 96 to 98%, 100-lb. drums, per pound	.27 to 37
Lead acetate, brown, broken casks, per 100 lb	16.00
" " white " " " "	19.00
" " " crystals, per pound	0.20
" C. P., test., granulated, per 100 lb	17.50
" " sheet, per 100 lb	14.50
Litharge, C. P., silver-free, per 100 lb	15.50
" com'l, per 100 lb	12.50
Manganese oxide, bulk, imported in barrels, per lb	0.09½
Manganese di-oxide, bulk, Caucasian (85% MnO_2, — % % Fe), in casks, per ton	60.00
Potassium nitrate, double ref'd., small cryst., in barrels, per pound	0.14½
" " " " granular " "	0.15
" " " " powdered " "	0.17½
" carbonate, calcined, in barrel lots, per lb	0.09 to 0.12
" permanganate, in drums, per pound	0.40
Silica, powdered, in bags, per pound	0.03
Soda, carbonate of (ash), in barrels, per 100 lb	3.00 to 3.50
" bicarbonate of " "	3.00 to 3.50
" caustic, ground, 98% " "	6.00 to 6.50
" " solid " " "	4.65 to 5.00

ELECTRICAL SUPPLIES

Armored copper cable, size 8, BXL 3, lead and armor, 100-ft. lots per 1000 ft	700.00
Armored copper cable, size 8, BX 3, armor, 100-ft. lots, per 1000 ft.	375.00
Conduit, galvanized iron, ¾-in., per 100 ft	10.65
" " " 2-in. "	33.45
Copper wire, size 0, bare, 200 to 1000-lb. lots, per 100 lb	18.70
" " " 10, triple-braid, weather-proof, coil lots, per 100 lb.	21.50
" " " 14, single-braid, rubber-covered " per 1000 ft.	7.35
Insulators, glass for telephone, No. 9 pony, per 1000	86.50
" " power, No. 14, per 1000	103.00
" porcelain, 6600 v., No. 44, per 100	19.30
Porcelain knobs, No. 5½, 10d. 'nailit', per 1000	26.40
" " " " solid, per 1000	20.20
" " " 3½ " "	69.20
" tubes, 5/16 by 3-in. "	9.05
" " ½ " 6-in. "	38.15
Sockets, weather-proof, molded, No. 60,666, per 100	27.60
Telephone wire, iron, size 12, half-mile lots, per 100 lb	8.75

EXPLOSIVES

Blasting-caps, No. 6, in lots of 5000, per 1000	17.06
" " electric, 6-ft., No. 6, in lots of 1000, per box of 100.	8.73
Blasting-powder, "B" soda, in 100-keg lots, per keg of 25 lb.	2.10
Dynamite, nitro-glycerine, 40%, in ton lots, per 100 lb	19.00
" gelatine " " "	19.00
" ammonia " " "	18.00
Fuse, common, in case lots, per 1000 ft	7.22
" waterproof, triple tape, in case lots, per 1000 ft	9.01

FUELS

Coal, Utah steam, $3.50 at mine, plus $7.50 freight to California terminal points, in carload lots, per ton	11.00
Coal, blacksmith's, in carload lots, per ton	21.00
" " in small lots, per ton	24.00
Coke, in carload lots, per ton	25.00
Fuel oil, per barrel	1.50
Diesel oil, per gallon	0.06
Distillate "	0.16½
Gasoline " "	0.22½

HARDWARE

Anti-friction metal, per pound	0.16
Babbitt, genuine "	0.42½
Brass sheets, half-hard and soft, per pound	0.24½
Drill-steel, hollow, first grade, in ton lots, per pound	0.18
" solid " " "	0.11
Fish-plate bolts, ⅞ by 2-in., per 100 lb	8.15
Nails and spikes (20d to 60d base), per keg	4.90
Nuts, hot pressed, ¾-in., hexagonal, per 100 lb	9.45
" cold punched " "	11.25
Picks, mining, 5-lb., per dozen	12.00
Shovels, carbon steel, No. 2, long handles, per dozen	15.00
Track spikes, ⅝ by 4-in., per 100 lb	4.90

HEAVY STEEL AND PIPE

Bar steel, soft, per 100 lb	3.75
Rails, steel, 16-lb., per 100 lb	3.80
Reinforcing-steel, per 100 lb	3.75
Sheets, corrugated, galvanized iron, 26-gauge, per 100 lb	6.55
" flat " " " "	6.45
" flat, black iron " "	5.90
Structural T's, channels, angles, and beams "	3.85
A deduction of 15c. per 100 lb. is made on the above when purchased in carload lots.	
Bars, steel, square, cold-rolled, per 100 lb	6.50
Pipe, wrought-iron, black, standard, 1½-in., per 100 ft	12.40
" " galvanized " "	15.70
" " black " 4-in. "	52.45
" " " extra strong " "	95.25
Shafting, cold-rolled (2¼ to 3-in. base) "	5.25

HOISTING-ROPE

Discounts for delivery from Pacific Coast stocks are: cast-steel, 22½%; extra strong cast-steel, 30%; plow-steel, 35%; blue-centre steel, 20%. The following illustrations indicate the net price for each kind of rope, in standard, 6-strand, 19-wire, 1-in. rope.

Blue-centre rope, per foot	0.40
Cast-steel rope, per foot	0.24
" " extra strong, per foot	0.26
Plow-steel rope, per foot	0.28

LUMBER

The figures given are subject to variation, depending upon the size and length. A charge for cartage is also to be added. Prices are furnished by Van Arsdale, Harris Co.

Fir, No. 2 clear and better, 1 to 2 in. thick, up to 16 in. wide, per thousand feet (M)	75.00
Fir, common, base price, per M	28.00
Fir, common, 6 by 6-in. up to 12 by 12-in., per M	34.00
Redwood, rough merchantable, 1 to 4 in. thick, per M	45.00 and 50.00
" clear, 1 to 2 in. thick, up to 12 in. wide, per M	90.00
Spruce, 'B' and better, 1 to 2 in. thick, up to 16 in. wide, per M	80.00
Sugar-pine, No. 1 and 2 clear, 2 in. thick, up to 16 in. wide, per M.	200.00
White pine " " " "	150.00

MISCELLANEOUS

Air-hose, 1-in., 5-ply, plain, per foot	0.48 to 0.65
Candles, 'Granite' mining, 6-16-40, 10-case lots, per case	6.40
Carbide, in 100-lb. cans, per can	7.75
Cotton waste, best grade, per 100 lb	14.50
Diamonds for drilling, according to size, per carat	50.00 to 75.00
Manila rope, grade 1, per pound	0.17
" " " 2 (standard), per pound	0.16
Packing, flax, per pound	0.33 to 0.85
" sheet "	0.25 to 1.00
" steam or water, first grade, per pound	0.90
Silex lining, crated, per long ton	41.00
Tube-mill pebbles, Danish, selected (in bags), per long ton	32.00
Zinc-dust, in 250-lb. boxes, per 100 lb	9.00
" sheet, 36 in. by 84 in., No. 9 gauge, in tons lots, per 100 lb	13.50

PORTLAND CEMENT, LIME, ETC.

Fire-brick, clay, per 1000, in carload lots, Livermore Star Brand	55.75
Fire-clay, in bags, per ton	18.00
Lime, lump, in barrels, per barrel of 180 lb	2.65
Portland cement, in bags, per barrel of 380 lb	3.95
Allowance of 15c. for bags returned in good condition.	
Portland cement, in barrels, per barrel of 400 lb	4.55
A deduction of 50c. per barrel is made on lime and cement when sold in carload lots.	

ORES AND MINERALS

The following prices represent approximately what can be obtained for the products indicated delivered at points on San Francisco Bay. These, of course, vary widely with the grade and purity of the ores. The present stagnant condition of the market makes many of the quotations purely nominal; most of the ores can be purchased at these prices, but it should be understood that it is not easy for the producer to market them at this time.

Antimony ore, approximately free of lead and arsenic, not less than 50% Sb, per %	60c.
Asbestos (crysotile), according to length of fibre, per ton	$20 to $2500
Barite, white and free of iron (crude), per ton	5 to 10
Bismuth ore, not less than 20% Bi, per % Bi	10 to 15
Feldspar, crude, lump, free of iron, per ton	5 to 10
Fluorspar, 85% calcium fluoride, per ton	15 to 20
Fuller's earth, ground to pass 80-mesh, per ton	5 to 10
Graphite, crystalline, per pound	3c. to 6c.
Magnesite, calcined, per ton	25 to 35
Manganese ore, less than 0.75% Fe; less than 6% SiO_2, per ton	25 to 30
Mica, according to size, clearness, and cleavage, per pound	1 to 8
Molybdenite, not less than 85%, free of copper, per % MoS_2	8 to 12
Ochre, according to strength, crude, per ton	8 to 15
Sulphur, 99.5% pure, only trace of As and Se, per ton	15 to 18
Talc, lump, white, per ton	7.50 to 10
Tin ore, not less than 60% Sn, per % Sn	4 to 6
Tungsten ore, not less than 65% WO_3, per % WO_3	2.75 to 3.00

Company Reports

BROKEN HILL PROPRIETARY CO., LTD.

Report for the year ended May 31, 1921.

Property: Mines, mills, plants, and steel works in Australia.

Operating Official: Essington Lewis, general manager.

Financial: Gross profits, £513,087 1s. 6d.; depreciation deduction, £161,755 12s. 3d.; net profit, £351,331 9s. 3d.

Production: Upon the cessation of the strike at Broken Hill on November 10 last, work was resumed as expeditiously as possible and continued for about two months, when it was found that operations could not be continued except at a serious loss, due to the increase in cost of labor and reduced working hours. Operations were suspended in January and have not been resumed. This serious position was accentuated by the disastrous fire that took place at the roasting plant at Port Pirie in January. The mine produced 3875 tons of ore during the period under review; the concentrating mill treated 4420 tons, producing 801 tons of lead concentrate. The re-grinding section of this plant treated 17,028 tons of tailing, producing 557 tons of lead concentrate and 2007 tons of slime. The slime-flotation plant treated 16,558 tons of slime, producing 1487 tons of lead concentrate, and 4257 tons of zinc concentrate. The production from the Newcastle steel works operated by the company was as follows: Pig-iron, 227,533 tons; steel ingots, 209,458 tons; coke, 240,905 tons; sulphate of ammonia, 3385 tons; and tar, 2,456,960 gallons.

NORTH BROKEN HILL, LIMITED

Report for the year ended June 30, 1921.

Property: Mines and mill at Broken Hill, New South Wales, Australia.

Operating Official: G. Weir, general manager.

Financial: Mine production, interest, rents, and dividends, £183,492 9s. 7d.; mine expenditure, £147,892 2s. 1d.; balance to appropriation account, £8128 15s. 6d.;

Development: The quantity of ore available for stoping above the 1400-ft. level remains unaltered and is estimated at 2,600,000 tons.

Production: Milling operations were resumed on February 7, and from that date till June 30, 32,300 tons of ore was treated producing 6461 tons of lead concentrate, assaying 65.5% lead, 28.4 oz. silver, and 7.3% zinc; and 6010 tons of zinc concentrate, assaying 48.1% zinc, 7.6% lead, and 9.6 oz. silver per ton.

General: The construction of the new flotation plant having been completed, the ore raised from the mine is now wholly treated at the company's mill and with excellent results, producing high-grade lead and zinc concentrates.

CITY DEEP, LIMITED

Report for the quarter ended September 30, 1921.

Financial: Working revenue, £598,885; total profit, £210,994.

Development: 6885 feet.

Production: 263,000 tons crushed for a yield of £2 5s.7d. per ton.

Remarks: The profit for the quarter constitutes a record for the company.

BROKEN HILL SOUTH, LIMITED

Report for the year ended June 30, 1921.

Property: Mine and plant in New South Wales, Australia.

Operating Official: W. E. Wainwright, general manager.

Financial: Ore extraction, treatment, mine development, and cessation expenses, £180,556 14s. 6d.; mine production and realization from previous periods, £131,727 14s. 7d.; loss, to appropriation account, £56,701 17s. 11d.

Development: 557 ft.; ore-reserves, 3,500,000 tons.

Production: mined, 37,007 tons assaying 14.4% lead, 8.7 oz. silver per ton, and 15% zinc; lead concentrates produced, 14,307 tons, containing 7801 tons lead, 510,560 oz. silver, and 1730 tons zinc.

General: A large portion of the report is taken up with the details of the various industrial disputes that occurred during the year.

CHIEF CONSOLIDATED MINING CO.

Report for the quarter ended September 30, 1921.

Financial: Receipts from shipments of ore, after deducting smelting, transportation, and sampling charges, $489,534.45; net profit after payment of all charges, $72,939.66; dividend paid August 1, $44,201.10, November 1, $44,201.10.

Development: Chief Consolidated mine, 10,654 ft.; Plutus mining company, 160 ft.; total of all development work, 10,814 feet.

Production: Tons, silver-lead ore, 9882; dry ores, 12,234; metal contents, 1142.153 oz. gold, 735,922.93 oz. silver, 3,270,749 lb. lead, and 3082 lb. copper.

Remarks: During the period of July 15 to August 15, the former world's record of 310 ft. was broken by a progress of 427.5 ft. in the Water Lily shaft.

AMERICAN TRONA CORPORATION

Report for the year ended December 31, 1920.

Financial: Expenses, $2,084,939.93; sales, $1,449,109.73; other income, $166,789.35; net loss carried to balance sheet, $267,794.02.

Production: 10,100 tons of potash salts and 4400 tons of refined borax.

General: The plant at Searles Lake continued operations until the end of April of this year, when it was deemed advisable to suspend, pending an improvement in market and general conditions. A small organization composed of experienced technical men are continuing research.

MODDERFONTEIN DEEP LEVELS, LIMITED

Report for the quarter ended September 30, 1921.

Financial: Working revenue, £397,254; total profit, £265,263.

Development: 2196 feet.

Production: 129,900 tons crushed for a yield of £3 1s.2d. per ton.

Recent Publications

Asbestos. By M. A. Allen and G. M. Butler. Bull. 113, Mineral Technology Series 24, University of Arizona. Arizona Bureau of Mines, Tucson, Arizona, 1921. 31 pp., ill.

Production of Explosives in the United States During the Calendar Year 1920, with Notes on Mine Accidents Due to Explosives. By William W. Adams. Technical Paper 291, U. S. Bureau of Mines, 1921. 44 pp.

Soil Survey of Northern Wisconsin. By A. R. Whitson, T. J. Dunnewald, and Carl Thompson. Bull. 55, Soil Series 27, Wisconsin Geological and Natural History Survey, 1921. 45 pp., cloth, ill., map. Madison, Wisconsin.

A Crystallographic Study of the Datolite from Westfield, Massachusetts. By Earl V. Shannon. No. 2385, from the Proceedings of the U. S. National Museum, Vol. 59, 1921. 61 pp., ill., diagram. Government Printing Office, Washington, D. C.

The Geography and Economic Development of Southeastern Wisconsin. By Ray Hughes Whitbeck. Bull. 58, Educational Series 6, Wisconsin Geological and Natural History Survey, 1921. 252 pp., cloth, ill., index, maps. Madison, Wisconsin.

Mining and Scientific Press

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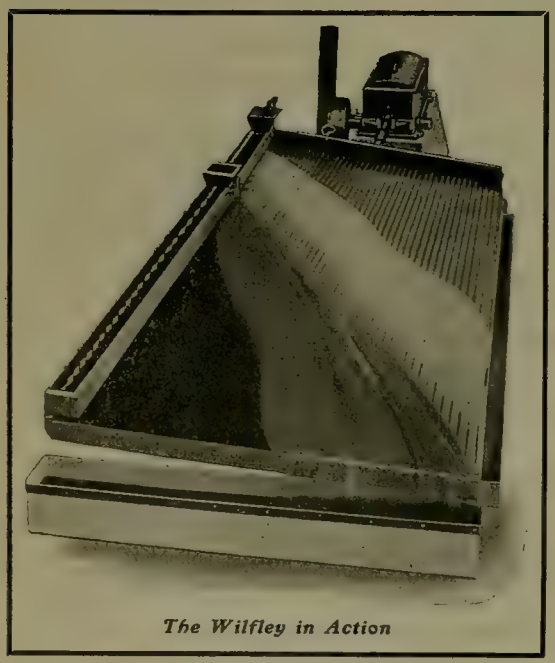

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T. A. RICKARD, - - - - Editor

THE burial of the unknown soldier at Arlington, and the various legislative enactments intended to assist those who served in the Army, express the sentiment of gratitude to those who fought and died in the War. There is one thing that could be done, particularly in San Francisco, to help disabled soldiers, and that is to give them the job of selling cigars. Every visitor to our city notices the large number of cigar-stands that occupy our street-corners; these are tended by vigorous men who might well be engaged in something productive and who could be replaced advantageously by crippled soldiers. The retail trade in cigars needs no salesmanship; the buyer knows what he wants and simply asks for it. Why not give the job to our soldier boys? Any cigar-store that set the example would win popularity at once.

WHAT proportion of the gross output of a gold mine is profit? The question is prompted by the answer, which we see before us in the form of the statistical record of three Rand mines as quoted in a recent issue of the 'South African Mining and Engineering Journal'. The three mines are the New Heriot, Village Main Reef, and Wemmer, all of which are now exhausted and dead. These are the figures.

	Tons milled	Total output	Dividends declared	Dividends per ton
Heriot	3,000,317	£5,575,745	£1,483,277	9.89s.
Village	7,005,952	12,249,101	4,080,143	11.65
Wemmer	1,038,364	2,647,327	839,180	16.16

Thus the dividends represent about a third of the value of the gold produced. This, we venture to say, is a high proportion. Here are a few others. The Bunker Hill & Sullivan, which is still very much alive, has paid 26% of its gross production in the shape of dividends; the Goldfield Consolidated paid 58%; the Alaska-Treadwell, 40%; the Camp Bird, 70%; the Mysore, 47%; the Mount Morgan, 40%; the Esperanza, 33%; the Robinson, 54%; and the Homestake, 25%.

A premium on gold as measured in paper currency is a pleasant thing for the miner in South Africa, but it introduces a factor so variable as to keep him in a nervous state. The rise and fall of the premium corresponds with the fluctuation in the value of the paper pound as measured in American dollars, so that the rate of exchange at New York is the barometer of industrial felicity at Johannesburg. When, for example, the paper price of gold drops from 115½ shillings per ounce, as it was in August, to 104 shillings, as it was in November, the operators on the Rand tremble for the solvency of their low-grade mines. Indeed, recently they felt such painful qualms that they went to General Smuts, the Premier of the South African Union, and begged him to do something for them. The General received the deputation courteously and reviewed the position in terms that met with their approval. He pointed to the fact that, out of the 39 active mines, 24 would have to be closed down if the so-called premium disappeared. Even a steady price of under 100 shillings per ounce would extinguish the profitable productivity of half a dozen mines. He said: "If, for instance, America cancelled the war debt owing by Great Britain to the United States, the exchange between Great Britain and America would be restored and the gold premium would disappear in one swoop". This illustrates forcibly how one man's food is another man's poison. However, it is considered unlikely that the British war debt will be cancelled, and it is even doubted if the cancellation would restore the exchange to normal, so our friends on the Rand may take another breath without feeling the pains of a financial pleurisy. One might say that the restoration of the pound to parity would be compensated by its greater purchasing power in terms of mining machinery and supplies, but unfortunately these economic readjustments do not take place simultaneously, as we know only too well from our own experience in this country. Therefore the South African Premier falls back on the one alternative—increase of efficiency. One suggestion is to allow the native to perform more of the work that is done by the higher-paid white employee. The miners' delegates protested, of course, against this proposed lifting of the 'color bar' and threatened a strike. To which the operators replied that they could either be reasonable or join the ranks of the already numerous unemployed.

TO the above we are able to add later news. General Smuts has scored again. It is estimated that his successful intervention in Rand affairs is equivalent to a gain of "at least 40%" in the efficiency of native labor at the mines. Hitherto the Kaffirs have been restricted to a 5-hour shift as against the standard 8-hour working day

for white laborers. This regulation, and the further limitations on the kind of work the native might do, has been a severe check to economy in the operation of the mines in and around Johannesburg. The new arrangement represents a concession on the part of organized white labor on the Rand and indicates that the unions realize the need, for themselves, of decreasing the operating cost so that sundry low-grade mines may continue to be operated profitably. The event is of paramount importance to mining in South Africa, and it gives us great pleasure to record it. At the same time it is announced that an agreement has been reached between the Custodian of Ex-Enemy Property in South Africa and the Public Trustee in England for the allocation of ex-enemy shares among the mining companies and financial houses, whereby some $30,000,000 worth of stocks will be absorbed, and thus cease to be a menace to the market.

UNDER 'Discussion' we publish a letter from Mr. H. M. Merry, of Salt Lake City, describing a graphic method for comparing three variables; he illustrates the application of his method to the solution of a problem in the leaching of copper ore. We understand that this isometric chart was first used by Mr. Merry when he was chief statistician, and, later, chief engineer for the Chino Copper Company, at Hurley, New Mexico. It proved a satisfactory device. Our old friend, Mr. H. W. Reed, also a resident of Salt Lake City, suggests that the metric system could be popularized by using English names for the units. Mr. Horace G. Nichols writes from Vancouver on the subject of the mining geologist, apropos of Mr. Augustus Locke's article in 'Economic Geology'. Mr. Frank Hall, of Tonopah, makes a plea for the prospector, and explains why he has disappeared. He attributes the result in part to the decay of the grubstake system and in part to the unfair treatment to which prospectors are subjected by engineers. We do not agree with Mr. Hall in the last of these conclusions, but we are glad to give space to a frank statement from one side, hoping that some representative engineer will join us in assuring the prospector that he is mistaken in assuming, as is done so often, that the engineer is as much his natural enemy as a fox to a fowl. We agree that one of the essentials to the discovery of ore is digging. The hotel-stove gossips or the plaza miners are not the fellows to find ore. More work, and less conversation, is needed for the purpose. A prospecting venture ought to be started locally, for it is on the small syndicate or the party of working miners aided by local tradesmen that genuine prospecting must depend, despite the large-scale and more scientific methods of big corporations. As for direct Government aid to prospecting, we have not come to that yet. The Government does assist by its scientific investigations and publications, and by giving special information to those who ask for it. If the prospector does not derive much benefit from such sources of knowledge, it is his fault, for the information can be obtained by anyone taking the trouble to ask for it. Some of it is couched in terms not understandable by those lacking a technical education, and it may be that the reports of the Geological Survey and of other Federal bureaus could be given a wider scope if written in simpler English. That is a suggestion that we have made more than once.

RETICENCE on the part of the officials of copper-mining companies as to the date on which operations will be resumed is natural for a number of reasons, one of which probably is a disinclination to encourage their old employees by premature announcements that might lead to disappointment. One of the first large companies to resume will doubtless be Utah Copper; unquestionably it could make a profit at the present price of the metal, but the company's large output would postpone the further reduction of the existing surplus to reasonable size. Accordingly, the policy of the company to defer resumption seems prudent. However, Mr. R. C. Gemmell, the company's general manager, has vouchsafed a "conjecture"—as the press-reports have it—that the date of resumption will be April 1, although he declares he cannot set any certain date. The estimated consumption of copper during November was 200,000,000 pounds, whereas the current production in this country and South America is only about 40,000,000 pounds per month. Considering the rapidity with which the surplus is being absorbed we risk the prediction that the idle employees of the Utah Copper Company can make their plans on the probability of returning to work not later than April 1—perhaps sooner. And in this respect the employees of several other copper companies may take a similarly optimistic view. The mines that produce the metal at a relatively high cost—say, 15 cents per pound—will have to wait awhile before they re-awaken to profitable activity. It is unlikely that the copper companies will act in unison in this matter of resumption of production, because their economic circumstances differ widely, and there seems no reason why the low-cost producers should wait until the market price of copper is high enough to ensure a profit to the high-cost producers. It is an example of the law of evolution: the survival of the fit, that is, those fitted to be successful under competitive conditions.

Royston, or San Antone

In these days of reviving cheerfulness in mining affairs it is pleasant to read of new finds that bear the promise of expanding activity. The old San Antone district in southern Nevada is attracting attention on account of the discovery of rich silver ore on a claim located long ago. The locality has been named Royston; the story has been published in a fragmental way at intervals in our news department during recent weeks. It appears that in October a miner named Frank Betts leased a strip of ground only 500 feet square from the Hudson Mining & Milling Company. With his partner, Cunningham, he started to work. They needed water and a means of haulage for supplies, their camp being 28 miles north-west of the nearest distributing point, which

is Tonopah; so they gave a quarter interest to the water-carrier, George Box, in exchange for his services. Another partner came in the person of a Chinaman, Charlie Poy, a dealer in poultry at Tonopah, who, like others of his race living in our Western mining communities, is alive to the spirit of mining adventure. Betts and Cunningham needed money for their prospecting, so one of them approached Poy, who went himself to see the ground and to judge of its promise as a mine. He bought a quarter interest for $150, and, it is sad to relate, was arrested for drug-selling soon after his return to Tonopah! He is now in jail. Meanwhile his partners went to work and almost at once uncovered a vein four feet wide of silver ore that assayed 'in the hundreds' of ounces per ton. Within six weeks, from a hole only 24 feet deep, they shipped $20,000 worth of ore. Ten tons sent to the McNamara mill realized $7150. So far the prospect has no dump, for all the rock has proved to be rich ore. Naturally there has been a rush to the locality and the Hudson company has granted a number of leases. This company is controlled by the Walker family of Salt Lake City and Mr. W. H. Royston, after whom the district has been re-named. Mr. Royston is superintendent of the Tonopah-Belmont Development Company's mill at Tonopah. Another fortunate owner of ground near the discovery is the Super-Six company, which with the Hudson company has joined in granting over 30 leases to parties of prospectors. The desert is dotted now with tents, and automobiles come purring from every direction. It is a 'boom', such as is most welcome at this time. Several of the companies operating at Divide and fortunate enough to have money in their treasuries have taken leases at Royston, so that systematic exploration on a considerable scale is assured. This part of Nevada is traversed by two nearly parallel ranges of mountains, the Toyabe and Shoshone. On the west side of the latter are the old mining centres of Lodi, Grantville, and Downeyville—not to be confused with the mining town of Downieville in California. Across the intermountain valley is Ophir canyon, where Mr. Louis Hanchett senior did some mining as early as 1876. This old camp is 15 miles north of San Antone, or Royston, which is in the southern part of the Toyabe range. At its extreme northern end is Austin. So, it will be noted, the surrounding region has been the scene of several mining excitements and of a good deal of desultory prospecting, but much of it has been explored only superficially and now invites closer examination. The story of the new find at Royston reminds one of the manner in which the rich silver orebody at Randsburg, California, was discovered, as related by Mr. A. B. Parsons in our issue of November 12. Such finds bring home the fact that mineral exploration is fortuitous and anything but scientific in its character. Much of the exploratory work done in our old mining districts was not guided either by knowledge or experience sufficient for the purpose, so that rich orebodies were missed, to be found almost by accident in these later days. Indeed, one may say that if a radio-active vision were vouchsafed to anyone, so that he could see through rock as a surgeon sees through human tissue to the vital organs, it would surprise him, and the rest of us, to discover how ineffective had been the search for ore on the part of the prospector and engineer, and how many rich orebodies had been missed.

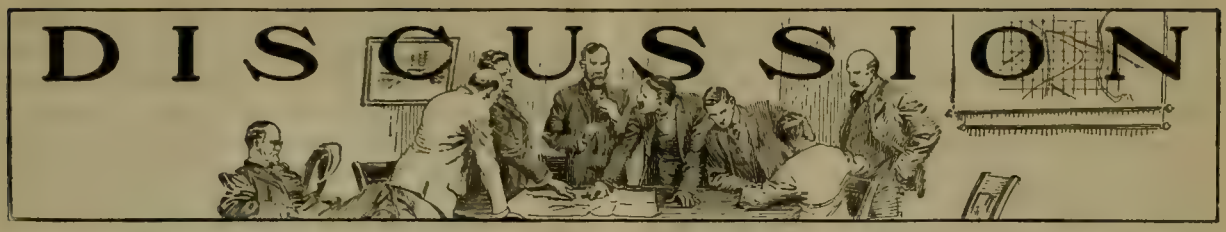
Freight-Rates and Mining

High freight-rates imposed by the railroads are strangling the mining industry of Nevada, according to the conclusions reached at a conference held last week at Carson City, in which participated representatives of the Nevada Mine Operators Association, the State Railroad Commission, the smelting interests, and of the railroad companies themselves. No inclination was manifested to condemn the railroads out of hand; rather, the purpose was to place the facts before the railroad officials with a view to demonstrating that "co-operation"—which in plain English means reduction of rates—on the part of the railroad companies is required to revive the mining industry, and that the railroads will suffer less financially from the lowering of freight-rates than from the loss of traffic attendant upon inactivity of the industry. The mine operators showed that, notwithstanding the lessened cost of labor, as well as of lumber and sundry other commodities, and notwithstanding the fixed market price for the metal in their ores, numerous gold and silver mines had been forced to suspend production on account of the high cost of transportation and high treatment-charges imposed by the smelting companies operating in Utah, where most of the high-grade Nevadan ores are treated. Representatives of the smelters thereupon submitted evidence to show that excessive freight-rates applying to fuel, limestone, and essential fluxing ores make it impossible for them to reduce the prevailing schedules of settlement for ores that they purchase. With the responsibility thus apparently thrown upon them, the railroad officials merely advanced the stock argument of high operating cost and assured the conferees that they were as anxious as anyone to stimulate the industry, and that rates would be lowered just as soon as such action could be taken consistently. It is unreasonable to place all the blame on the railroads, for there are too many other factors; nevertheless the proceedings at Carson City are significant for the reason that the condition of the mining industry in Nevada is typical of that in every other Western State; indeed, every industry throughout the country is suffering under handicaps arising from high freight-rates. One of the principles on which is based the system of making freight-rates, is that the rate shall be low enough to 'move the traffic' so long as it does not involve an actual direct operating loss. This principle depends upon two simple but sound theories: (*a*) that more traffic permits a thinner distribution of overhead and fixed charges, and (*b*) that traffic begets traffic. If, for example, the silver mines at Eureka, Nevada, were producing ore today, instead of lying almost idle, materials, machinery, and supplies of all kinds would be flowing into Eureka, and

the railroads would be earning a net profit even if the revenue derived from freight on ore only equalled the direct cost of the actual hauling. The railroad officials know to a cent just how low they can afford to fix rates to the end that the mines and smelters may operate profitably; it is possible, but unlikely, that this point has been reached in the establishment of a great many rates. We venture to say, however, that, if the railroads were independent agents, as they were twenty-five years ago, there would be an immediate downward adjustment that would put many an industry on its feet. Now, with the Federal Labor Board determining the wages of railroad employees on the one hand, and the various State and Interstate commissions fixing rates on the other, the railroad executives naturally are circumspect and cautious in voluntarily reducing rates below the maximum prescribed by the commissions. This does not necessarily imply an opinion that the railroads are subjected to too much regulation; but it does point to the fact that close governmental regulation is not an unmixed blessing. It seems altogether probable that many of the existing rates in Nevada can be lowered to the mutual benefit of all concerned. Reductions of one kind and another are being announced daily; specific instances of lessened rates on ore and concentrate in Idaho, Montana, Utah, and Arizona have been recorded in our news columns during the last two months. The institution of proceedings, the holding of hearings, and the final obtaining of a decision from the Interstate Commerce Commission would have consumed the greater part of two years; the mine operators of Nevada desired immediate action. They displayed excellent judgment in arranging the recent conference and in stating their case candidly to the railroad officials. Relief should be forthcoming.

A Detachable Rock-Drill Bit

The fundamental operation of mining is the breaking of virgin rock. The force is supplied by dynamite, but to make the strength of the dynamite in any degree effective it must be detonated in a long slender hole; therefore, the making of this hole is the primary act of mining. Forty years ago the first air-driven rock-drilling machines were manufactured, and since that time they have been gradually improved until, in the light of present knowledge, they seem to be efficient, although it would be rash to prophesy that the present type of drill will not be obsolete by the end of the next decade. The machine, however, is only a source of power; the instrument that actually eats into the rock is the piece of steel that receives the 1800 blows delivered each minute by the hammer, and is rotated by the machine. As someone has remarked, the "whole mining operation is pyramided upon the drill"; indeed, he might have gone further and said that it is based upon the drill-bit. If the constant grinding against solid rock did not wear out the bit, the mine superintendent would be spared one of his troubles. The intelligent observer would ask, "Why not make the drill of better steel?"; the answer is, the cost would be prohibitive. The question then arises, why not weld to the drill a short piece of high-grade steel and use this for the bit? and when the impracticability of this is explained a really perspicuous observer would ask, "Why not make a detachable bit?". That is exactly what inventors have been trying to do for twenty years. In the Patent-Office at Washington repose dozens of designs of detachable bits that look exceedingly well on paper. Some depend on springs, others on pins or wedges or keys or sleeves or threads to make the union, but none of them has been able to stand the hard work in a mine. The advantages of a successful detachable bit so small that a machine-man can carry half a dozen in his pocket are well known, but the more important of them are worth enumerating: (*a*) it will avoid a vast amount of unnecessary work in collecting dull drills from the stopes and drifts, carrying them to the station, hoisting them to the surface, and delivering them to the shop—a succession that must be reversed when the sharpened drills are returned to the mine; (*b*) it will save the wages of blacksmiths and helpers, the first cost of elaborate drill-sharpening shops and machinery, besides the fuel and compressed air used; (*c*) it will diminish measurably the amount of steel needed, as represented in short drills that are thrown away, dull ones that are thrown into the fill by irate drillers, and the metal that is burned each time a drill is sharpened; (*d*) is will increase the efficiency of the actual drilling operation because the greater durability of alloy-steels will promote efficient cutting while the drill is in the hole; (*e*) it will obviate waiting at the face for sharp steel, or, on the other hand, the necessity for continuing to use the old pieces when they are too dull for efficient work; (*f*) it will reduce the amount of compressed air consumed per foot of hole drilled. According to the 'Anaconda Standard', such a device has now been perfected by Mr. Arthur L. Hawkesworth, a mechanic in the employ of the Anaconda Copper company. A brief description says that the novelty consists of a special double taper by which a bit of vanadium-steel, weighing only a few ounces, is securely fastened to the end of a piece of ordinary drill-steel. It is claimed that the bit will 'stand up' under severe service, that it will not jam in the hole, that it consists of a single piece with no delicate parts to wear or break, and that it can be loosened for removal by one tap on the right spot with a hammer. This sounds almost too good to be true, but it is said that repeated tests have been made in the mines at Butte and that some of the officials of the Anaconda company are convinced that the bit will be a success. It might be supposed that the manufacturers of drill-sharpening machines and the makers of drill-steel, who may lose some business at the outset, will not look with favor on such an innovation; but we feel safe in assuring the doubtful ones that the manufacturers are much too far-sighted to frown upon any invention that will help so much to promote the prosperity of the mining industry. If Mr. Hawkesworth's device proves to be only a flash in the pan, it is to be hoped that someone else may invent a workable bit.



Graphic Analysis of Three Variables

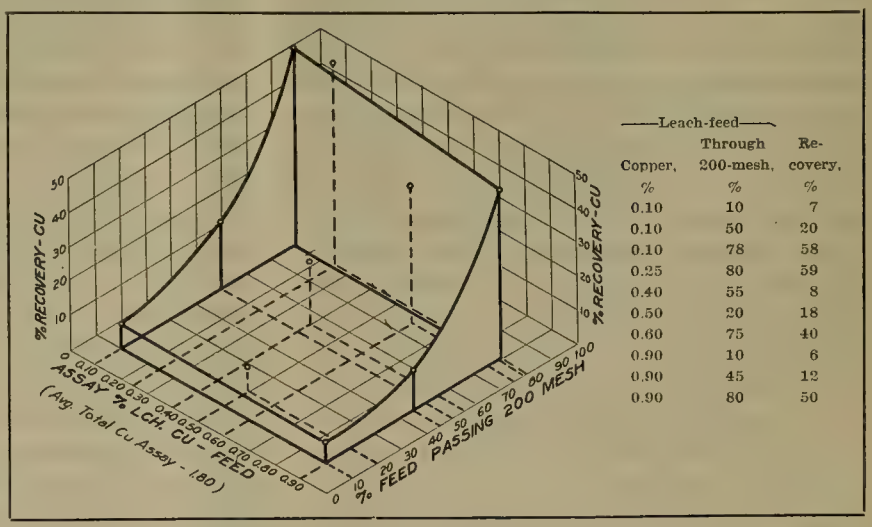
The Editor:

Sir—In the course of exhaustive researches into the many phases of metallurgical practice now commonly conducted by all mining companies, the investigator is called upon not only to satisfy himself of the truths apparently revealed by his work but to convince the operating staff of the value of the evidence obtained. The latter is not always easily accomplished, so it may not be amiss to present a graphic device that performs a definite service for the engineer so engaged, both for his own clearer conception and for the visual enlightenment of his principals.

The accompanying chart-form possesses the useful quality of comparing three variable factors simultaneously and in a strikingly unmistakable manner. To illustrate the method, comparison is made between the influence of acid-leachable copper and of finely-ground feed upon the recovery of copper from a flotation process. Although the data used are imaginary, a similar condition from mill practice, showing characteristics fully as marked, is within my recent experience. The scheme was utilized in an effort to analyze the same problem, and a long-standing argument between two schools of opinion was settled so effectively thereby that it seems worth describing for the use of others.

Ordinary isometric-ruled paper is used. Scales are chosen within the limits of the data for the two base ordinates, X and Y, which should represent the influences to be weighed; the vertical, or Z ordinate, should indicate the recovery, or the result upon which the influences are supposed to act. From the intersection of the plotted X-Y ordinates, the vertical Z ordinate is erected on a convenient scale. When all data are plotted, if marked characteristics are observed, typical curves should be superimposed; these will represent the average course of the influence lines and thus illustrate the condition. When dealing with a phase into which more than three factors enter, each factor should be plotted alternately with all others, to avoid the chance of reaching a wrong conclusion.

In the example it is clearly apparent that the degree of recovery is directly proportional to the amount of material passing 200-mesh in the feed, and that the assay percentage of acid-leachable copper is of slight influence. Points along the X-axis, both maximum and minimum, show almost no variation in relative magnitude, whereas on the Y-axis a pronounced increase in recovery follows finer grinding of the feed.



Leach-feed		
Copper,	Through 200-mesh,	Recovery,
%	%	%
0.10	10	7
0.10	50	20
0.10	78	58
0.25	80	59
0.40	55	8
0.50	20	18
0.60	75	40
0.90	10	6
0.90	45	12
0.90	80	50

ISOMETRIC CHART FOR COMPARING THREE VARIABLES

Judiciously employed, this scheme should be useful in analyzing, for example, the influence of the various and often deleterious salts present in the leaching solutions of hydro-metallurgical processes, or in any study in which the effect of two or more influences upon a result is to be ascertained; it is possible to visualize relationships and tendencies that are not comparable by other methods.

I do not claim originality for the chart-form, which is well known to electrical engineers and mathematicians, among others; but its application to practical metallurgical or engineering investigation is believed to be novel and worth while.

H. M. Merry.

Salt Lake City, November 2.

Metric Weights and Measures

The Editor:

Sir—I believe that one reason why we have made so little progress toward adopting the metric system is be-

cause the names mean nothing to ninety-nine million of our people. If Congress would by law make the yard-stick equal in length to the French metre and call it a metric yard, and then divide it decimally, its adoption would present no difficulty and invite little objection. In the same way we could have a metric quart. We already have a metric ton, why not have a metric mile? I make the suggestion and leave it to your readers to see how easy the details can be worked out without taking up valuable space in your journal.

Salt Lake City, November 11. H. W. Reed.

Why the Prospector has Disappeared

The Editor:

Sir—In your issue of April 23 appeared an interesting and instructive article on prospecting. I ask you to publish a prospector's view of the subject.

In pioneer days when every stream was alive with fish and when there was an abundance of game, all that the prospector required was a little bacon and flour. There was plenty of feed for his burros or pack-animals, but this has since been appropriated by the cattle-man or has been destroyed by sheep. The country was virgin and unexplored. Every day held forth a promise that rich ore might be found. Mines and croppings stuck up out of the ground. In one prospect in Nevada, which afterward became a famous silver-lead mine, $80,000 worth of ore was exposed in the outcrop at surface. When the early prospector was short of grub, the old-time manager gave him a job; not infrequently he returned to offer a prospect that later became the property of his employer; or he could easily obtain a grubstake, a good investment when the country was new, for a mine might be found on a small investment. The grubstake is the foundation of many an American fortune. The expert was not so much in evidence in those days.

The engineer never knew how to deal with the old-time prospector, many of whom owned good properties but had no conception of the value of money; they would speak of $100,000 or $1,000,000 as if it were a trifle. During the early history of Virginia City, Nevada, a company that had developed a mine desired to purchase the adjoining ground. The manager met the prospector on the street and told him to be at the bank at 10 o'clock the next day, when he would receive $60,000 in cash for his holdings. At the appointed time he was there with a sack to receive the money. The bank teller paid in $20 gold pieces, counting it out in $1000 piles. By the time $30,000 was in sight the prospector swept it into his sack and beat a hasty retreat, thinking he had been overpaid. It was more real money than he had ever seen. I have never heard of a case in which real money or greenbacks were offered that did not turn the trick for much less than the price asked.

Lack of croppings of commercial ore, lack of capital to develop, and the attitude of the engineer are the principal reasons for the disappearance of the prospector. I never could understand why the capitalist should ask the engineer what a prospect is going to be worth when it is developed; he should consult a fortune-teller on such subjects. The practical man has developed more mines from the prospect stage than the engineer has, and the attitude of the employer toward the engineer is a result of this condition. The question should be: Will a property warrant the expenditure of a certain sum in development? Thus far I have heard of no man who can definitely value an orebody ahead of the churn-drill or the pick. The prospector has just cause for complaint about the way some engineers treat a prospect. I have offered a property, and the reply would be: "No, Bill Jones looked at it; there is nothing there". Or a corporation clerk will look through his files and you can be sure if your property is black-listed by adverse data there will be nothing doing. Why doesn't the engineer keep his mouth shut except to his employer and not injure an industry upon which his bread and butter depends? So far as the prospector is concerned he might as well quit and abandon the property, which has been done in a number of instances. I ask whether the practical man or the engineer can go on the witness-stand and swear whether a prospect will or will not make a mine. An engineer brought up this subject by saying: "Now that certain copper properties in Arizona have become mines, the adverse reports about them should be withdrawn". Who is going to discover the mines in the future if the prospector quits? The time is drawing near when there will be no new properties to examine. The engineer should foster legitimate mining. I have met engineers in the field who took an interest in instructing the prospector by giving him geological points about his property. The bigger they were the better fellows I found them to be.

The mines and croppings of commercial ore that stuck up out of the ground were found by the old-timers long ago and are now worked out. You can be certain that if you discover a new property in any section of the United States at present you are going to have to do some digging. If big corporations would stop and do some digging with a portion of the funds needed to keep engineers encircling the globe more mines would be discovered. The modern prospector should possess a field assay-outfit and have a thorough knowledge of geology. He should be able to make field tests for the rarer metals and other minerals that are of commercial value. A great deal of surface trenching is required in the softer inconspicuous veins that were formerly overlooked, as well as constant assaying. It takes from one to two years diligent searching and hard work to discover anything worth while; this requires more money than the average prospector possesses. Prospecting can best be conducted by the incorporation of a small exploration company that can keep a man in the field for a definite time. A great deal of valuable information as to where to look for a mine can be found in various books written by able geologists and in publications of the U. S. Geological Survey; schools of mines are also of great aid; but knowledge alone is not sufficient. If you are going to get a new

generation of prospectors in the field, more encouragement and financial aid must be given.

The prospector's greatest difficulty after making his find is to get financial aid. He cannot do enough development to interest the corporation engineer, and he has no funds to go to the industrial centres to offer his property for sale. It usually gets into the hands of someone in the nearest local town, or of a promoter. When his price is added to that of the prospector's the enterprise is too top-heavy to finance. A prospect will not stand the overhead expenses of fancy offices, clerk hire, and high-priced managers. Every dollar should be spent on the property. This can best be ensured by forming a corporation in which at least 80% of the money raised is expended in actual mining development. Many Eastern investors imagine they have bought mining stocks; as a matter of fact they have invested in gilt paper that is paying the personal expenses of some wild-cat promoter. These professional yeggmen have stolen thousands of dollars from the small investor and have absorbed all the capital that should be available for legitimate investment. A peculiarity of the tribe is that they can look you square in the eye, and lie for hours without batting an eyelash. The legitimate promoter, who makes possible the creation of new wealth, should be encouraged, not only in mining but in other industries.

It is well known that the large development corporations distribute their risks over several properties; so much is put into each one until a mine is discovered. All commercial business ventures are not a success. You would be fortunate indeed if you landed a big mine in the first prospect that was tested. An element necessary for success is that the man spending your money should understand his business. Thousands of dollars have been spent in building mills where there were no mines, and in running long tunnels where a prospect-shaft following the ore would have told the tale at a fraction of the cost. Other ill-advised operations are seen in the case of small companies with about $15,000 capital that start to sink a shaft through 1000 ft. of rock to reach the ore-bearing formation, whereas $150,000 or more is required to do the work. If your money is invested in one of those partly financed propositions you are sure to lose it. Something has been done for the next fellow that comes along, if it ever is completed. The engineer has the necessary training and should enter the field as a promoter; thousands of dollars could be saved. It is true that the development of prospects is highly speculative, but if properly conducted it is not more so than other speculative business.

The mining of precious metals in the United States is declining. At one time the prospectors of California and Virginia City, Nevada, saved the credit of the nation. Our country has grown from a swaddling infant to a huge industrial giant, who still has the trappings of childhood hung about him in the shape of red-tape and old laws. The apex law is a point in question. It was designed for the benefit of the apex attorney. No excuse can be found for such a law and there are as many reasons as a porcupine has quills that it should not exist.

I note that there is a great deal of discussion of the proposed new mining law. It seems that the few remaining prospectors have not enough difficulties in their path; new ones must be added. Some of the clauses are designed for the benefit of corporations and to the detriment of the prospector. If the object of the law is to discourage individual prospecting, it will accomplish the purpose admirably. Should the finding of new prospects be left to the corporations, our public mineral domain will be as silent as the Sahara desert. We have enough poorly enacted laws; what the prospector needs is legislation that will aid him. Our legislators should be patriotic and broad-minded enough to know that new discoveries will be made by individual effort as they have in the past. If more obstacles are put in the way, prospecting will cease.

Canada is encouraging the development of its mineral resources in many ways; the Government builds roads and trails for the prospector; a Government engineer makes a free examination of the prospect, and reliable data can be obtained by the capitalist who is looking for properties. In some Provinces the State grubstakes the prospector for an interest, and he can purchase powder and mining supplies at cost. If the American prospector had some of these advantages the mining industry would soon recover and the production of mineral wealth increase by the discovery of new mines.

Our national budget amounts to $5,000,000,000 this year, but I have not heard of anything being done to help the prospector or the mining industry. It is up to our national representatives to do something for mining, for the welfare of the nation.

FRANK HALL.

Tonopah, Nevada, October 15.

Geological Mining

The Editor:

Sir—Philosophical definition of facts and beliefs involves much metaphysical reasoning, and consideration of the subject brings to mind an appreciation of the grounds upon which beliefs are based and the extent to which such are dependant upon the elements of time and knowledge. It is the part of wisdom therefore to recognize the dominant importance of principles.

The swing of events and of policies is due to the human tendency to disregard this conception. In some cases the underlying principle is so clear that but little variation results from the changing aspect of conditions; in others, however, existence itself is threatened.

It is curious that no more illustrative symbol can be used than the upbringing of a child by its parents. On what does the continuance of a parent's active influence depend, and how often does it continue more than a memory of childhood? So much for generalities.

Perhaps it is not too much to say that however clear may have been the scope and function of his profession to a mining engineer, it has taxed the powers of the best to present an ample and convincing statement of them to the public at large. I beg you, gentlemen of full persuasion,

to bear with me a moment; there is, I fancy, something to be said, even yet, upon this point, and I hope to make it clear. But first consider how many branches of the profession there are. We all know men who are unexcelled at reconnaissance work, at organization, at development, at equipment, but there are not many who excell at all of them. Remember that the public at large does not appreciate the inter-relation. Suppose that in course of time it became apparent that one of these branches had attained to such a degree of specialization as to encourage it to launch out as a separate profession; the public of that time might be excused for dissociating such work from its conception of the functions of a mining engineer.

It has been my privilege recently to hear an address by a well-known geologist and mining engineer who impressed upon his audience of mining engineers their duty of convincing the public by asserting themselves. In what way are mining engineers to assert themselves in such fashion as may be free from risk of variation due to changing conditions? I think that this may only be done through a clear enunciation of the principles underlying the profession, and I suggest that the following remarks upon the geological side of mining are pertinent to the inquiry.

In a recent paper by Augustus Locke that appeared in 'Economic Geology' the standing of the economic geologist was presented in a new light. It came as a surprise that so great a part of the theme should be based upon imperfect recognition of the geologist's work, and the first thought to be engendered was: Surely in these days no one can wish to belittle the achievements of the geologist or fail to acknowledge the basic influence of his discoveries.

But Mr. Locke is not concerned so much with these days as with the days to come, and not so much with the geologist's record to date as with the potentialities of his work in the future. so he broadens his view and reaches out into the fields executive for his appliers of geological science. Essentially the proposition is sound. Mr. Locke asks, from what source are such men to be drawn? I think the answer to that question is: from the ranks of the mining engineers. It may be that such an answer was intended. On the other hand, to some it may appear that the pendulum is swinging, and that the impetus of the justifiable recognition of his proved essential value might carry the geologist beyond the direction of useful endeavor.

Terminological discussion resolves itself into quibbling unless the aim is an enunciation of principles, but where such purpose is involved, the choice of methods of expression should not be lightly disposed of with a shrug and "What's in a name?" If the mining engineer is to assert himself before the public, his claim to recognition should be based upon the fundamental principles of his profession.

What is the mining engineer for, not only now, but always? One hesitates to show ignorance upon a subject that has been so ably discussed and exponded, but if it is true that a mining engineer is understood to be a man whose training and experience fit him for the work of searching for, and the recovery of, minerals, with all that such a definition implies, from prospecting to finance, and if it is shown that ore-hunting is a profession for the geologist, what is the poor public to understand?

Excluding the coal and oil industries from the discussion for the moment, is it possible that our old friend 'ore' can be brought to trial again? Relegated to the text-books to describe metal-bearing minerals, may we let 'pay-ore' take a place in the definition of the mining engineer's functions, to the end that the economic geologist may be concerned with finding ore and the mining engineers with all that pertains to pay-ore? Or would it be better to coin a new term of 'mineral geologist'?

The above remarks are intended as an introduction to the suggestion that the relations of the studies of geology and mining are two-fold, and may be expressed by the terms 'mining geology' and 'geological mining', and in particular it is desired to lay stress upon the scope of the latter. The study of the habits of orebodies is so intimately associated with considerations of structural geology that it is unnecessary to emphasize the inherent need of geological knowledge for a mining engineer's guidance. The extent to which a close observance of structural facts may influence operations is an argument in favor of the possession of that knowledge by the men who are responsible for the conception and execution of policy. In one case recently noted, the imminent approach toward a zone of fracturing in the course of following an ore-shoot downward pointed to such changes in the conditions of oxidation and stability of the ground, as to warrant a complete change in a projected plant and in the methods of development and stoping. In another case, the gradual change in direction of orebodies, occurring in limestone near a contact with grano-diorite, from being parallel with the line of contact to almost right angles to it, as depth was attained, led to an appreciation of the increased influence of a series of crossing fractures as channels for the mineralization and to a change in the policy of prospecting development at a lower level. Again, the fact that concentration in disseminated copper orebodies in monzonite, lying between later quartz-porphyry dikes, was found to occur at points where the course of these dikes was deflected, assisted the realization of the function of these dikes as indicators of lines of weakness, and gave rise to the exploitation of orebodies in quite other directions.

A mining engineer may not know the difference between an esker and an Esquimo; he may be even quite unprepared to dive into the depths of geological reasoning about periods and magmas. There is no call for him to drown himself—the mineral geologist will relieve him of responsibility on these scores—but he must possess an alertness, born of knowledge, that will enable him to grasp the significance of geological facts as they present themselves in the course of his work, if he is to fulfill the demands of the profession that seeks to stand before a public with confidence in its power and responsibility.

Vancouver, November 24. HORACE G. NICHOLS.

The Education of a Mining Engineer

By T. A. Rickard

*When starting a discussion it is well to begin by defining the terms to be used. What is a mining engineer? The word 'mine' comes from the Latin *mina*, an excavation underground for destroying a fortification; later it meant a hole in which an explosive was placed for a belligerent purpose. Thus we have the word 'undermine'. Hamlet says:

"But I will delve one yard below their mines,
And blow them at the moon."

The original meaning of the word 'mine' survives in 'menace', a threat, and in 'minatory', a synonym for 'threatening'. The word 'engineer' likewise comes to us from the technology of the Roman soldier, for it is derived from *ingenium*, a military device, a war-engine, a battering-ram. The derivation is more evident in the French spelling, *ingenieur*. The idea of inventiveness survives in the word 'ingenious', and it fits the engineer, who is skilful in originating. The military connotation of the two words 'mining' and 'engineer' was revived during the recent war, when our professional friends and kinsmen came from the Yukon and California, from New Zealand and Missouri, from the remotest corners of the earth, to join in fighting in behalf of the great cause. One member of our profession, Ralph S. G. Stokes, who in the first week of the War went from New York to London to enlist as a private in the British regiment of Royal Engineers and rose by force of merit to the rank of Lieutenant-Colonel, served as 'Controller of Mines' in Flanders; he supervised the preparations for the tremendous 'blow', or explosion, at Messines on June 6, 1916. That was a truly great 'mine' in the original sense of the word.

You will recall Mark Twain's definition of a mine as "a hole in the ground owned by a liar". The definition is amusing; but many an untrue word is said in jest; the liar is not the honest prospector of whom we think as the owner of a young mine, but a much less responsible person, the promoter whose regard for truth is so great that he rarely uses it, the so-called fiscal agent who converts an honest excavation into a purring 'wild-cat', with claws—and whiskers! I insist that the mining engineer is connected with a legitimate form of industry, the main purpose of which is to make money by winning the valuable metals and minerals from their rocky matrix within the crust of the earth. The object of mining is not—as is supposed by some—to spoil the scenery of the beautiful parts of the earth or to afford employment to the sons and nephews of the favored few. Nor is it the primary purpose of mining to obtain cross-sections for the elucidation of geologic problems or to gather data concerning the increment of temperature in depth. No; the motive of mining is neither academic nor altruistic; it is, in plain English, to make money, honestly, by producing the metals and minerals essential to the very existence of our material civilization. Engineering has been defined as "the art of directing the great forces of Nature for the use and convenience of Man". That is the motto of the Institution of Civil Engineers in England. On the United Engineering Societies building in New York it is written: "Engineering, the art of organizing and directing men, and controlling the forces and materials of nature for the benefit of the human race". This is idealistic, and not wholly true, for the art of engineering is applied usually not with benevolent purpose but for honorable gain—to the engineer himself, to his employer, to the community, but rarely for the express benefit of the human race. That is too large an order.

Again, it does not seem to me correct to define engineering as "the art of organizing and directing men". That is pre-eminently the art of the politician! A man can be a great engineer without ever taking charge of the men that do the work of construction. He is better for the experience, but it is not essential to his art. However, when we do think of mining engineering as used for the benefit of mankind, we think of Herbert C. Hoover, who applied his experience as a manager of mines to a great humanitarian task. He fed ten millions of Belgians and French at a total administrative expenditure of less than half of 1%—to be exact, 0.42%—of the cost of the entire operation. That reminds me of a story.

Several years ago Mr. Hoover was crossing the Atlantic and happened to sit at table next to a British gentlewoman of the Early Victorian type. After passing the salt and offering the Worcester sauce once or twice, he became acquainted with her, as one does aboard ship. He told her of his travels in China and Mexico, in Australia and Burma; and she found the young man both agreeable and interesting. Near the end of the voyage, by which time they had become pleasantly acquainted, she asked him, "What are you, Mr. Hoover?" He answered, "An engineer". "Oh!" she exclaimed, "I thought you were a gentleman!" She thought an engineer was an engine-driver; and probably to her a gentleman meant a person without visible means of support. If she lived to the time of the Great War and read of Mr. Hoover's achievements as dispenser of nutrition in Europe and as Food Administrator in the United States, she may, in her quiet home in rural England, have awakened to the fact that an 'engineer' may

*An address delivered on the occasion of the semicentenary of the Missouri School of Mines, at Rolla, Missouri, on November 5.

be several kinds of a man, and sometimes, as Shakespeare says, "he is a proper man's picture".

Well, what is a mining engineer? I know of only one definition that is sufficiently comprehensive: he is a man that does the work of a mining engineer, namely, the management of mines, the examination and appraisal of them, the work of surveying underground, the planning and devising of ways and means for winning ore. A degree from a University or a School of Mines does not make a mining engineer; the degree merely certifies to an adequate scholastic preparation for the work. Many graduates from mining schools have never practised the profession for which they were prepared; they have become brokers or druggists, for example. On the other hand, sundry brokers and druggists have dropped their original vocations and learned enough of the art of mining to examine mines, to appraise them, and even to manage them. When they did that they were mining engineers—some of them may not have been the best of their kind, but they earned the designation by doing the work. I am reminded of the New York City boy who was on a summer excursion in the country and asked the teacher, "What kind of a boid is that?" You know that the boys from the East Side say 'thoity-thoid' for 33rd, 'foist' for first, and 'boid' for bird. So this boy asked, "What kind of a boid is that?" The teacher said, "That is not a boid, it is a bird". "But", replied the boy, "it makes a noise like a boid." It did. So a man that makes a noise like a mining engineer—talks like one, does his work like one—is a mining engineer, whether he be duly certified or not. In some States he must be licensed, and if he can show a diploma it is easier for him to obtain a license—for example, a shorter period of apprenticeship is required—but otherwise he has the same chance as his friends—for they are his friends—whom we may term 'diplomatic' because they have diplomas. It is well that this should be so, for our American ideal is the equality of opportunity; we recognize no privileged class, even of scholars; it would be unfair to debar any young man from reaping the reward of the training that is acquired in irregular ways, by night-study, by association with helpful seniors, by reading, observing, and experiencing the things requisite for the development of capacity as a professional man. Several honored members of our profession entered it by the side-door—not the back. One distinguished veteran was a carpenter and the son of a carpenter, with none of the advantages typified by such an institution as the Missouri School of Mines. Another began life as a sailor; a third, as an accountant; a fourth, as a botanist. I am speaking of men now acknowledged to be in the first rank. Many, of course, began life as laborers in mines and mills; starting to do manual work when their more fortunate comrades of the future were still at school. The chief difference between them and the 'regulars'—those who underwent the conventional training—is that they acquired their knowledge more slowly, more laboriously, and they reached positions of emolument comparatively late in life. The chief purpose of school or college is to learn how to learn. The preparatory school to which I went has for its motto *"Non scholæ sed vitæ discimus"*. "We learn not for school but for life." It is perfectly logical, for example, when licensing a man as an engineer or admitting him to membership in a professional society, to require as a qualification more years of responsible service from a non-graduate than from a graduate, because an unschooled mind is slower to apprehend than one that has been trained.

Here we come to the definition of education. Education is the process of educating; the word is derived from the Latin *e*, out, and *ducere*, to lead; it means the leading out or bringing forth of the innate powers of an individual; it means the bringing up or rearing of a child; and it applies to the children of a larger growth, to us all, whose education continues throughout life, until our mental faculties become atrophied. 'Live' and 'learn' are conjoined advisedly, for when we cease to learn we may as well die. It is said that John Richard Green, the historian, asked that his epitaph might be, "He died learning".

So we have considered the meaning of the terms used in our subject, the education of a mining engineer. It means the proper training of the young man who intends to do the special work that is required in connection with mining. Mining is an art, or a skilful method of doing things; to it the various sciences are applied with a view to improving the method. So we learn mathematics, mechanics, physics, mineralogy, and geology; the knowledge obtained is less important to us than the manner in which it is obtained, for what we learn in a school or a college is of small consequence, and soon forgotten, as compared with the training of our mental faculties so that we may be able to think clearly, observe accurately, and state truthfully. This we cannot do unless we use our language properly, for truthfulness of statement depends upon the proper use of the words that are the symbols of thought. Therefore we engineers should learn how to speak and write—particularly to write—intelligently and intelligibly. Of all the instruments of precision used by a mining engineer the one that he uses most is his own language—the language that came from the old country, from Chaucer and Spenser, from Steele and Addison, from Shakespeare and Milton. It is a beautiful language and a flexible instrument of expression. Our mining engineers are well grounded in the various 'ologies; they have been well drilled in the requisite number of sciences; but they do not appear to see the prime necessity of acquiring the one accomplishment without which the others may prove ineffectual. I shall speak plainly.

During recent years public attention has been drawn to the need of teaching English, more particularly to those who are undergoing training for an engineering career, because it has become recognized that our profession is sadly lacking in the ability to speak and write effectively. We—you and I—may be especially critical of this defect because we know that it is necessary to use the language correctly in describing or discussing technical operations and ideas; but defective English is common to our American youth generally—boys and girls

alike. Much has been said on the subject and many are the causes to which these shortcomings are ascribed. I venture to be frank with you in stating that one cause is our democratic way of living. Do not mistake me: I am keenly in sympathy with the democratic idea: I believe it to be the best stimulus for the further progress of our civilization, and I believe that the destiny of our country is to develop the idea of democracy for the benefit not only of ourselves but of the world at large. If we are intellectually honest, however, we must recognize the fact that democracy levels down as well as up. For example, you and I, the audience and the speaker, belong to the professional class, a class that is differentiated not by wealth but by education, by the possession and use of brains that have been trained for our several vocations. Our children go to the public schools, which follow the democratic custom of allowing all children, of whatever class, to share the same instruction. I use the word 'class' as the equivalent of 'type', not to signify any recognized social stratification as in Europe. Our children at school sit side by side with others that come from homes where defective English is spoken, from the homes of aliens who have not learned to speak our language properly, from the homes of those of our own native stock who did not go to school in their youth or who for other reasons are illiterate. The children sit together and they play together, in good democratic fashion; they acquire the same habits of speech; the young negro, the young Japanese, the young Italian, the grocer's boy, the hod-carrier's son, the laborer's girl, the parson's son, the professor's daughter, all sympathetically and naturally acquire the same kind of language. The result is that those who speak it badly learn to speak it less badly, whereas those who speak it well learn to speak it less well. That is why the children of our professional men do not speak as well as their similars in England, whereas the children of the laborer, the hod-carrier, the plumber, and the grocer speak and write much better than their similars in the old country. There the sons of professional men go to school with the sons of other professional men—to schools that resemble our private schools—where they do not associate with those reared in illiteracy. The effect is to perpetuate a social distinction; to make good speech a mark of class. We obliterate the class distinction, we sacrifice the facility for acquiring correct speech to the supreme ideal of our democracy, namely, an equality of opportunity. I do not cavil at it; it is worth while, but we must recognize the penalty—a small one relatively—that we pay for the sake of our ideal.

Next comes the question, should we continue this system of education in common although it have a result prejudicial to a part of the community? Speaking broadly, it seems to me that we should continue to sacrifice the literacy of a few for the sake of educating the many, and that a division of our children according to class or vocation would be a step backward; but we can remedy the obvious consequence by insisting upon more and better teaching of English in our schools and universities. For example, our mining schools should make it a part of their duty to improve the speech and writing of their students by maintaining a class in English at least for the freshmen, as most of them do already, and by requiring a good standard of writing throughout the successive years spent in technical education. An examination paper in mechanics or mineralogy, in physics or geology, should be required to reach a standard not only in the knowledge of the science but also in the art of expression. It may be said that it is no part of the duty of a School of Mines to teach English, which should have been taught to the student in the high-school. The answer is that we face a condition, not a theory; and if the students come insufficiently trained in a matter so important as the use of their language, it is only fair and wise to give them the necessary training before it may be too late. I note that in this School of Mines three hours per week during the first and second years are allotted to English; moreover, a class in technical writing is maintained for the senior students; in this respect you set a good example.

Next I shall refer to another cause of poor speech and bad writing. Many of our young men seem to think it democratic and American to talk in a slovenly way; and the habit, I think, affects their writing. When college graduates start to work at the mines they desire to seem 'practical' as soon as possible, and in order to be friendly with the workmen they are deliberately careless in their speech, avoiding nicety of expression as if it were effeminate. Some, I am sorry to say, appear to think it necessary to imitate the 'mucker' and acquire methods of speech common to illiterate workmen, as if it were manly, as if in protest against the high-brow or academic cult. In consequence, many young fellows from homes of refinement, the sons of well-educated parents, the graduates of great colleges, the pupils of distinguished scholars, talk and write deplorably. It is a huge blunder to suppose that such a failing is either democratic or American. To be either one or the other it is not necessary to be unseemly in manner or uncouth in speech; on the contrary, I say with confidence that a young American democrat should aim to be as courteous in manner, as decent in bearing, and as correct in speech as any aristocrat of the old world, but he should be just 15% more intelligent. It is intelligence that classifies men in a democracy. The greatest democrat of all, Abraham Lincoln, did not think it improper to speak and write carefully. In his public utterances, spoken or written, he endeavored to use good English; indeed, he developed a skill that made his speeches and writings models of classic excellence. It remains a perpetual miracle that a man with so few educational advantages should have acquired such a mastery of the language that the best of his utterances are unexcelled in the literature of our race. The Gettysburg speech and the Second Inaugural address are, and will remain forever, models of exquisite diction and consummate oratory. How did Lincoln acquire this remarkable skill? First, he had few books to read, but they were of the best: the Bible, 'Pilgrim's Progress', Shakespeare, Æsop's 'Fables', and Blackstone. His mind sought good company. He walked miles to borrow a book on grammar and he gave his spare

time to it while tending the village store. I like to think of young Lincoln lying at full length on the counter of Greene's store at New Salem, his head propped on a pile of calico prints, while he read 'Kirkham's Grammar', or sitting in the shade of a tree while he studied Blackstone's 'Commentaries', which he found among some discarded papers at the bottom of a barrel. He did not have to read the yellow press of today or even the dialect stories in our current magazines; so he escaped the contagion of jargon. His Gettysburg speech contains only three words not in the Bible; they are 'continent', 'proposition', and 'civil', but all three are to be found in Shakespeare. He drank freely at that well of English undefiled, the King James version of the Bible. The language of the Bible and of Shakespeare is the best part of our familiar speech. Here I may mention that now no student at Harvard can receive his degree without passing an examination in the Bible; indeed, the authorities at Cambridge rank the Bible and Shakespeare as "two works of literature without which an adequate appreciation of English letters is impossible". This rule is not prompted by devotional or religious motives, but by the same cultural considerations as caused Huxley to advocate the reading of the Bible in the public schools of London. To good books Lincoln owed much; but in part his astonishing skill was due to another cause, only recently made known. He lived in an illiterate community and among people who spoke badly; when listening to his associates and hearing their yarns in the local store he noted their inability to express themselves successfully; he thought about it, and made the experiment of putting their sayings into more careful language; he would go home and write down the story that had been told clumsily and then proceed to put it into better words; that is, he edited what his friends had said. Thus he gained skill in the use of speech; he realized that there was a technique of language and he set himself to acquire it; and he did acquire the technique so thoroughly that his words, warmed by his genius and glorified by his spirit, will echo forever down the corridors of time.

So, gentlemen, no American can say that it is undemocratic to speak like a gentleman or to write like a scholar. On the contrary, we technical men, who have to deal with subjects requiring precise presentation, should be particularly desirous of using the instrument of expression with care. The difference between good and bad writing is chiefly the difference between being careful and being careless. It is not difficult, if one desire to do so, to learn to write respectably. To acquire the art of Lincoln, of Ruskin, or of Stevenson there is needed more than care, more than conscious effort; but ordinary skill, sufficient for most of us, can be acquired by anyone willing to take pains. Genius has been described as one part inspiration and nine parts perspiration; we can be nine-tenths of a genius if we have the capacity for working with sincerity of purpose. Only recently I overheard a woman say to her companion in a suburban train: "I'd like to be able to write clearly without stopping to think about it". She was one of many, of those who would like to do a thing well without the trouble of thinking; but it cannot be done in respect of anything to which thought is essential. However, she was not unlike some of my young friends in the mining engineering profession who use the chisel of language as if it were a screw-driver. It is astonishing how many graduates from universities will write: "The data *is* sufficient", "the propaganda *are* objectionable", "the agenda *was* printed". An Assistant Principal in a School of Metallurgy wrote to me that he observed "*this* same phenomena in other kinds of glass"; and, as if to show that the error was not inadvertent, he repeated it twice. When I wrote in a kindly way to warn him, he apologized, but intimated that he was rather pleased with his skill in writing. How often we read of proposals to tax "the necessities of life", as if being subject to necessities were not sufficient cause of unhappiness without our being taxed on account of them. The tax is levied on the 'necessaries', the staple articles, not the necessities that they satisfy. This use of the abstract instead of the concrete is characteristic of the windy utterances of politicians. It reminds me of the Babu—a half-educated Hindoo—who, when declining an invitation on account of the death of his mother, wrote: "Regret I cannot come, the hand that rocked the cradle has kicked the bucket".

Well, I have said enough concerning one phase of the education of mining engineers; if I say more you will charge me with attempting to make journalists of them. After all, before one writes one must have something to say. As to that, I doubt if any men have more opportunities to gain information and to see the world at large than the members of our profession. American engineers have gone to the remotest corners of the globe, following the lead of their British comrades. In South Africa and Western Australia they have made their mark; in Canada and South America they fill today many of the chief positions in the management of famous mining enterprises. They have participated in the development of the principal mines of Siberia. Just now the shrinkage of capital and the temporary abatement of the spirit of mining adventure have restricted their activities abroad, but the time is coming when they will be called again in large numbers to foreign fields of activity. The reason they are wanted is because they are efficient, particularly in their clear-headed appreciation of the business side of mining, plus an intimate acquaintance with the latest technology. [May I digress for a moment: when first I went to Colorado, 36 years ago, I made the acquaintance of a number of Columbia men, who proved exceptionally successful in their profession. I used to wonder why they had done so well; I did not impute the result to exceptional teaching in mining or metallurgy; in later years I have put it down to the fact that they came from Boston and Brooklyn, and that they underwent a severe grueling in mathematics at the hands of Professor Van Amringe. Indeed, he seems to have played the part that your Professor Dean appears to have filled in this School of Mines.] The United States can boast many excellent mining schools—that of Missouri is one—but the reason why our men are effective is due to the larger fact that the United States is a great mining country; indeed, it

is a continental area in which are found many mining regions of diversified character, yielding nearly every one of the metals and minerals required by our material civilization. We may be short of tin and antimony; we may not possess deposits of chrome and manganese so generous as those to be found elsewhere; but in a broad way our country is exceptionally endowed with mineral resources. Therefore it offers a post-graduate school of mining unsurpassed in the world at any period of human history.

Another condition favorable to the development of competent mining engineers in the United States is the social status of our profession. If one of you were to take a young Englishwoman in to dinner and ask her what was her idea of a mining engineer, she would say, probably: "A somewhat nomadic person connected with queer doings on the Stock Exchange". An American girl would reply differently; she would, I believe, intimate that the mining engineer was a half-back with a scientific education, competent to dig gold out of the ground and to manage men at least as well as the colonel of a regiment. In England the mining engineer ranks socially below the officers of the army and navy, below the barrister and physician, below the people who live on the rents from land and the coupons from bonds; indeed, the profession is so young compared with the survivals of an ancient system that it has not yet come into its own. In our country the mining engineer may call at the White House and shake hands with the President as a matter of course. When Cecil Rhodes established his scholarships at Oxford he aimed to promote international goodwill, but, although he had gained his wealth in mining, it did not occur to him to found a College of Mines at Oxford. If he had done that, he would have accomplished a great benefaction for the profession and for the mining industry of the British empire, but such an educational foundation would have been a complete departure from British tradition—especially at Oxford, "the home of lost causes and forsaken beliefs". In our own country the chief mining schools are attached to, or are integral parts of, our universities. That is as it should be. Most of our engineers have enjoyed some of the advantages of a university education along with their technical training. It is becoming recognized that the preparation for a bread-and-butter dependency, for a salaried 'job', is not an education in its true sense, and that to make men of real worth, likely to be happy and useful, prepared to do the work of the world as effective citizens, there must be some culture, some bringing forth of the faculties that distinguish *homo sapiens* from the rest of the *genus homo*. "Man does not live by bread alone." If our great experiment in democracy is to succeed it will be by reason of "the moral worth and intellectual clearness of the individual citizen". The mob cannot help, nor will the yellow press; education can do it by bringing the right men into leadership. The University of Missouri and its School of Mines can forward the consummation of a great ideal, and I feel confident that they will.

It has been my privilege to know most of the leading mining engineers of the world, in this and in other countries, during the last thirty years, and I am informed concerning the careers of many of them. In a broad way they are an exhibit for the educational methods of the last quarter of the nineteenth century. What can we learn from their biographies?

In the first place, the successful mining engineer—the man who has won the esteem of his fellows and established himself in an extensive and lucrative practice as a manager of mines or as a consulting engineer—is not always a college graduate nor even a man trained in a mining school. About one in seven has missed these advantages. I use the word "missed" advisedly, for if he had been better educated he would have been even more useful and efficient. The lack of educational advantages and the comparative poverty of his parents to which this was due have had the effect, however, of compelling him to work harder and have tended more strongly to develop his character—to make him industrious and self-reliant. To be given a good education and to start life without the urgent need of earning a living is not always the best thing for a young man, especially if he lack initiative and ambition. In a democracy, as in other types of social organization, it will be found that those who are born with a silver spoon in the mouth are likely to die with gold filling in the teeth, without having accomplished anything more decorative. It is proper that we should admire the man who makes his own way. For example, your own most distinguished alumnus started life as a poor orphan lad, reared on a small farm; he earned money for his schooling by hard work; by dint of personal effort he won his way to this School of Mines and here obtained the lever by which he opened the world oyster, in the shape of the greatest copper mine on this continent. To give an education to such men is the finest investment a nation can make.

When I review the life-histories of the men whom I admire and respect I realize how much their university education has expedited their mental development and hastened their arrival at positions of influence. Only men of extraordinary force of character have been able to achieve success without such help, and, it is sad to say, they represent the few survivors of hundreds who failed for the lack of such help. In the days to come the chances of the unprepared will be even less, for the demands made upon engineers, in the way of scientific training, will become increasingly exacting.

Much of men's success seems to be due to accident. This one was lucky in making the acquaintance and arousing the personal interest of a leader; that one happened to be on hand when a particular post had to be filled in a hurry; another had the special experience required for a special piece of important work at a given time and place; a fourth had personal qualities that won the goodwill of the president of a company or the manager of a big mine—and, needless to say, gentlemen, I rate the manager of a mine above the president of a company. So it seems as if much of life were fortuitous; as if men became successful through accident. This is a superficial view; on the contrary, it will be found, on closer scrutiny, that the success is due to the man being

ready for his chance; to his having prepared himself for many contingencies, so that when opportunity knocked at the door he was ready to rise and give instant welcome to the visitor. Our own deeds are our doomsmen.

"There is a tide in the affairs of men,
Which, taken at the flood" [to which Byron added]—"you know the rest,
And most of us have found it, now and then;
At least we think so, though but few have guessed
The moment, till too late to come again."

Some, like children, only wade in the shallows and so fail to feel the greater impulse out at sea; they fear to swim in deep water and are left behind, high and dry. Our life is as "the sands betwixt two tides".

The difference between men is chiefly the difference of character. Education develops character—that is the very essence of education. A man of character goes through the shoals of circumstance as a ship directed by a captain with a compass and a chart; a man lacking character is like a ship without control that drifts upon the reef and suffers shipwreck. Herbert Spencer said that "of all the ends to be kept in view . . . all are unimportant compared to the end of character-making. This alone is national education". In the last resort mere cleverness will not take a man far; there is needed something more dependable, and dependability is character. A man of character will act in the same way under the same conditions. Give a man of character a liberal education and he becomes the finest product of our civilization. It is the product that an educational institution such as yours aims to give to the United States—worth more than much fine gold or a million tons of copper. A liberal education is the aim of all true scholastic effort; but there is no complete agreement as to the necessary curriculum. After all, a liberal education is the product of an ideal that transcends the curricula of the schools. Permit me to quote from the greatest expositor of the nineteenth century, Thomas Henry Huxley:

"That man, I think, has had a liberal education who has been so trained in his youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a cold-logic engine, with all its parts of equal strength and in smooth working order; ready, like a steam-engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness, and to respect others as himself."

Huxley was the Dean of the Faculty of the Royal School of Mines—my alma mater—a school that was royal not by reason of kingly patronage but because it had for teachers such men as Huxley, John Tyndall, Lyon Playfair, Edward Forbes, and John W. Judd. Gentlemen, permit me to transmit to you this description of a liberal education as the greeting of the Royal School of Mines of London to the School of Mines of Missouri on the occasion of its 50th anniversary.

Pulverized Coal

Firing with powdered coal has many characteristics to recommend its use. Its principal advantages over hand- and stoker-firing lie in the comparative ease of conveying it to furnaces and in its practically complete combustion with little excess air in close contact with the material to be heated, thus avoiding the convection, radiation, and excess air-losses which accompany hand- or stoker-fired furnaces placed outside reverberatory and many other furnaces. For this reason its most successful field of use has been for those purposes where it has replaced externally-fired furnaces. For purposes such as steam-raising where the burning coal can give up heat directly by radiation to the boiler-heating surface, there is therefore less opportunity for reducing the fuel consumption by burning powdered coal instead of burning coal on a grate, since the losses which may be reduced by substituting powdered coal-firing for hand-firing or stoker-firing are those only which are due to incomplete combustion and using excess air. These losses, however, are not inconsiderable, says John Blizard, of the Department of Mines of Canada.

Before powdered-coal firing may compete successfully with grate-firing it is obvious that the gain due to the smaller consumption of powdered coal must offset the cost of preparing, conveying, and burning it. When firing with powdered coal, ash is blown into the furnace, out through the stack, and, with some badly-designed furnaces, out through openings in the furnaces. It may also form a troublesome slag, and fill up the flues so as to impede the draft. Nor, on the whole, can powdered-coal plants be said to be clean. There are fairly clean powdered-coal plants; but generally a plant using powdered coal is dirtier than a grate-fired plant. At one plant using it, and visited by the writer, the quantity of coal blown out from furnaces was so objectionable in rivet-heating furnaces, with the air-suspension transport system, that it has been replaced by oil-firing, in spite of the fact that powdered coal was cheaper fuel than oil. At another plant where powdered coal delivered by the air-suspension transport system was used for forge-furnaces, it was found that the increased cost in repairs to presses and cranes near the furnace, due to powdered-coal firing, amounted to 23c. per ton, and the additional cost for repairing furnaces to 15c. per ton. Nor has powdered coal always given as satisfactory a heat as stoker firing. At one plant visited, they had abandoned powdered coal for firing forge-furnaces, because either the gases passed through the furnaces at so high a velocity that it was impossible to obtain a soaking heat, or, if retarded by closing the damper, ash was blown into the mill. It must not be understood from the foregoing that powdered-coal installations have proved unsuccessful. On the contrary, they have generally proved most succesful. The use of powdered coal has seldom been discontinued after once being adopted.

Proposed Revision of the Mining Law

A Report Adopted by the Mining Committee of the Commercial Club of Salt Lake City

The so-called Arentz Bill, introduced in the House of Representatives on July 12, 1921, by S. S. Arentz, of Nevada, provides for the revision, amendment, and codification of the laws of the United States relating to the location of mining claims on the public domain. One of the best analyses of the proposed bill, which has been subject to much discussion in the Western mining States, was written by Mr. James H. Ball, chairman of a subcommittee of the Committee on Mining of the Salt Lake City Commercial Club. The report is reproduced herewith almost in its entirety:

SECTION 1 provides that the Act may be cited by the short title of 'United States Mining Act'.

SECTION 2. Lands valuable for minerals are reserved from sale, except as otherwise expressly directed by law.

SECTION 3 provides that all valuable mineral deposits in lands belonging to the United States shall be open to exploration and purchase by citizens of the United States, and those who have declared their intentions to become such. Since rights in lands containing potassium, coal, phosphate, sodium, oil, oil-shale, and gas are acquired under the terms of other Acts of Congress it is provided that these deposits shall be unaffected by the Arentz Bill; neither does it pertain to withdrawals of public lands which have been or may hereafter be made.

SECTION 4 prescribes the manner in which proof of citizenship may be made.

ARTICLE 'A' OF SECTION 5. By this article it is provided that every claim upon unsurveyed lands shall be located in the form of a square, laid out on cardinal lines, conforming to the system of public-land surveys; and that claims upon surveyed lands shall also conform to the subdivisions of the public-land surveys. In our judgment, in order to perfect a valid location, this requirement as to the manner of location would make the employment of a surveyor necessary, and in that way a hardship would be worked on the average locator of mining claims, with the result that the making of mining locations would be discouraged, except as to men of means or wealthy corporations.

By this article it is also provided that the size of a full claim shall be 40 acres; but claims containing 10 acres may also be located in the form of a square. Under the present law a claim may equal but shall not exceed 1500 ft. in length along the vein or lode, and may extend 300 ft. on each side of the middle of the vein. It is not necessary under the present law that the locator take this maximum area, since at his option his claim may be shorter and narrower. For instance, it may be 1000 ft. in length and 200 ft. in width, but under the Arentz Bill a claim containing 10 acres and in the form of a square, laid out on cardinal lines, seems to be the minimum in acreage. Under such circumstances we do not see how a locator can conform his location to a long and irregular outcrop without including and paying for unnecessary acreage.

ARTICLE 'B' OF SECTION 5. This article provides that a discovery of valuable mineral shall not be necessary in order to locate and hold a mining claim; and that a claim located without discovery on land classified as mineral, may be held for five years without discovery, after which time it shall be open to re-location. It is also provided that upon failure to make discovery within the period of five years a locator shall have the right to hold the claim or claims for further annual terms not exceeding five years, by payment annually in advance of $50 for each acre, or fraction thereof, which annual payment shall be in lieu of any further requirements for assessment work.

ARTICLE 'B' OF SECTION 5 should be considered in connection with Article 'B' of Section 6, which provides that on each claim until patent has been issued, not less than $5 worth of labor shall be performed or improvements made during each year for each acre, or fraction thereof, comprised in such claim; or that in lieu of the performance of such labor a sum calculated at the rate of $5 for each acre, or fraction thereof, may be paid each year into the United States Land Office for the district.

From careful consideration of the provisions just alluded to, it will be perceived that by virtue of Article 'B' of Section 5, a locator, without any discovery whatever, and without a penny's worth of work leading to discovery, may obtain the exclusive possession of a claim or group of claims for a period of 10 years. True, under the requirements of Article 'B' of Section 6, he must, during the first five years, either expend in labor or improvements, $5 per acre for each acre, or fraction thereof, contained in his location, or pay into the Local Land Office an equivalent in cash; but whether he shall do the work or deposit the money in the Local Land Office is a matter which is left to the discretion of the locator. Possession during the last five years of the 10-year period does not contemplate the performance of annual assessment work, since it is provided that the privilege of holding the claims for this additional five years may be acquired by the "payment into the Local Land Office annually in advance of $50 for each acre or fraction thereof, which annual payment shall be in lieu of any further requirement for assessment work".

Thus it will be seen that for at least ten years land may be held without anything whatever having been done during that period toward the development thereof, or the extraction of the minerals supposed to be contained

therein. We do not think it is advisable to amend the present law so as to make it possible without doing the annual assessment work thus to hold lands classified as mineral, when, as to all mineral lands, the performance of development work and the extraction of the minerals is the thing desired and to be encouraged. In addition to the retardation of the actual development work, the proposed amendment would in our judgment work a hardship on miners who depend for a livelihood on the employment arising from the work usually done and the improvements usually made in the performance of assessment and patent work.

Article 'C' of Section 5. This article provides that upon making discovery, the locator shall file in the Local Land Office a sworn statement as to that fact, showing the nature thereof; and that upon verification of such discovery by a United States Deputy Mineral Surveyor, (which examination shall be at the expense of the claimant) the owner of the claim shall be entitled to hold it under the same conditions as though discovery had been made before the original record was filed in the Land Office. Discovery effected by drilling more than 100 ft. in depth may be established by affidavit of at least two persons thoroughly acquainted with the facts, which proof shall be accepted as *prima facie* evidence of discovery.

Under the present mining law the locator does not incur any expense in proving his discovery. Before issuance of patent the Government, through its field division, makes an investigation without expense to claimant for the purpose of satisfying itself that the necessary discovery has been made and that the required amount of patent work has been done. It appears to us that the provisions of the present law are much more simple and satisfactory than the method contemplated by this article, which method seems both cumbersome and expensive.

Article 'D' of Section 5. This article provides that where no proceedings have been initiated in the United States Land Office to acquire a non-mineral estate in public land, classified as non-mineral, mining claims may be located thereon with or without discovery.

We fail to perceive any necessity for such a provision, since under the present laws provision is made whereby mineral land improperly classified as non-mineral, may be subjected to proper classification and patented as mining land. We fear that under the pretext of locating mining claims, lands would be tied up for purposes foreign to mining.

Article 'E' of Section 5. By this article it is declared that one discovery shall be sufficient to support the holding and patenting of a maximum of four contiguous full claims aggregating 160 acres (if held in common ownership), or 16 contiguous 10-acre claims aggregating 160 acres, if held in common ownership.

Under the present law, a discovery is a condition precedent to the validity of every mining claim. Annual assessment and patent work for a group of claims may be performed on one claim of the group, provided the work done on the selected claim is calculated to accomplish the development of the group, under a scheme or plan for their common development. But nevertheless a discovery on each claim of a valuable deposit of mineral is essential. Under the change contemplated by the Arentz Bill, a discovery on each claim of a group will be unnecessary. Four contiguous full claims of 40 acres each, or 16 contiguous 10-acre claims may be held and patented by virtue of one discovery on any one of the group. This provision should be carefully scrutinized. In size, a 10-acre claim is exactly comparable with one of our large Salt Lake City blocks. Assume for convenience of consideration an area of four of our city blocks in width by four in length, or from Main street to Fourth East street, east and west, and from Brigham street to Fourth South street, north and south, which in acreage would be equivalent to sixteen 10-acre claims. Under the proposed change an area equal in size to 16 of these large city blocks may be held and patented on the strength of one location made, say, far up in the north-east corner of this large tract, even though as a matter of fact $\frac{15}{16}$ of the area was absolutely valueless as mining land. But this is not all. There is no limit to the number of lode claims which one person or a corporation may locate, and consequently group after group containing sixteen 10-acre claims would in this manner be subject to acquisition by any one having the capital necessary to pay the purchase price of $5 per acre.

We do not think it should be made so easy for any one to abuse the privilege of acquiring mining property.

Article 'F' of Section 5. This article deals with the location of placer claims in Alaska, and consequently will not be discussed.

Article 'G' of Section 5. By this article the time after the date of original location within which entry and payment shall be made for mining claims located after the effective date of the proposed new law is fixed.

Article 'H' of Section 5 provides that in all cases of an application for a patent to mineral land a discovery shall be a condition precedent.

Article 'A' of Section 6. This article deals with the question of marking the boundaries of mining claims and the posting of notices of location. In the interest of all concerned we believe that Congress should fix a definite minimum requirement as to the marking of claim boundaries; and in this connection, since most mining claims are located on lands, the surface of which is quite irregular, we are of the opinion that a permanent monument at each corner of the claim, as well as one in the centre of the end- and side-lines, would prove to be a just and satisfactory requirement.

Article 'A' of Section 6 also provides that all notices of claim location, whether located before or after the effective date of the proposed bill, shall be recorded in the United States Land Office of the district in which located. The duty to record and the expense thereof rests with the locator. While for the reasons hereinafter stated, we are of the opinion that it is very desirable that a complete record of all mining claims should be available for inspection at the Local Land Office, we do not believe

the duty to record or the expense thereof should be cast upon the locator. Concerning the desirability of having in the Local Land Office a complete record of all mining claims in the district, we call attention to the fact that quite often officials of the Local Land Office entertain applications of one sort or another affecting lands which are covered by valid mining locations. For instance, as the law now stands, the owner of a perfectly good and valid mining location may find that under the Oil Leasing Bill a permit has been issued authorizing someone else to prospect the same lands. This situation would have been obviated had there been a record in the Local Land Office of a notice of location covering the land embraced within the prospecting permit.

ARTICLE 'B' OF SECTION 6 provides for the performance of annual assessment work, or, in lieu thereof, the payment into the Local Land Office of an equivalent amount of cash. We have previously discussed this subject.

ARTICLE 'C' OF SECTION 6 provides that upon failure to comply with the conditions as to annual assessment work or payments, the claim shall be open to re-location in the same manner as if no location of the same had ever been made.

ARTICLE 'D' OF SECTION 6 provides the procedure under which one of several co-owners may be "advertised out", for a failure to contribute his proportion of the required expenditures.

ARTICLE 'E' OF SECTION 6 deals with the period during which annual assessment work is required to be done, and establishes the fiscal instead of the calendar year therefor.

Should the proposed bill be enacted, Articles 'B', 'C', 'D', and 'E' of Section 6 should become a part of it. In other words, they should stand or fall with the bill. And as shown in the concluding part of this report, we think the bill as a whole should fail of passage; since except for one or two matters there suggested, there is no necessity for changing the present mining code.

SECTION 7, while necessarily recognizing existing extra-lateral rights, repeals the 'apex' law as to all claims which may be located after the effective date of the proposed bill. By this Section the holder or patentee of a mining claim obtains the exclusive right of possession and enjoyment of the surface and minerals which lie beneath the claim and within vertical planes passing through the surface boundaries, but is denied the right to follow any mineral deposit beyond such planes.

We believe that in repealing the 'apex' law, a provision should be made to offset the situation that otherwise would result in the case of a comparatively flat vein dipping into the earth at a slight angle. With extra-lateral rights abolished, a claim 600 ft. in width by 1500 ft. in length, as authorized under the present law, located along the strike of such a vein, would give the locator only 300 ft. of the vein on its dip, assuming he had locatel so that the outcrop passed the centre of his end-lines. This small segment of the vein would not justify development expenditures. We therefore think that under such circumstances the locator should be authorized to locate a claim in the shape of a square 1500 ft. by 1500 ft.

With the exception above noted, we are of the opinion that the 'apex' law, with all its baleful incidents, should go; and we also are of the opinion that the language of Section 7 is appropriate and legally sufficient to accomplish the end sought.

SECTIONS 8, 9, 10, 11, AND 12 relate to the procedure to be followed in connection with the acquisition of patent and include such questions as adverse claims against applications for patent, descriptions of claims, surveys, verification of application papers and affidavits, etc.

Should the proposed bill be enacted into law, these sections should become a part of it.

ARTICLE 'A' OF SECTION 13. By this article a mill-site or works-site of not exceeding ten acres of non-adjacent non-mineral land may be acquired by the owner of a mining claim for mining and metallurgical purposes. This provision is very similar to our present mill-site law except for this purpose under this article the applicant is permitted to patent ten instead of five acres. If the Arentz Bill shall be enacted, this article should be incorporated therein.

ARTICLE 'B' OF SECTION 13 provides that where unoccupied land belonging to the public domain, either contiguous or non-contiguous to a mining claim, is needful in large areas for mining and metallurgical purposes, the surface rights of such land may be acquired without limit as to aggregate area, providing the application has been approved by the Secretary of the Interior. Land classified as being capable of irrigation may not be located under the terms of this act. By Article 'C' of this section mineral rights underlying land thus acquired shall be reserved and shall be subject to location and patent.

If the Arentz Bill becomes law, Article 'A' of Section 13 should become a part thereof; but we are not aware of any necessity for the provisions of Article 'B' and 'C' thereof, since it has never come to our attention that "land without limit as to aggregate area" is needful for mining and metallurgical purposes.

SECTION 14. By this section all moneys paid into the Land Office in lieu of annual labor or improvements, and for extension of tenure beyond five years where no discovery has been made, shall be set aside and be known as the "mineral development fund", to be used within the State and as nearly as practicable within the mining district from which payments were made, for the general purpose of developing the mineral resources of the several mining districts.

As previously stated, we believe the development of the land itself is the thing to be desired; and we therefore are of the opinion that, as at present, annual assessment work should be performed on the claim, and that there should be no alternative.

SECTIONS 15 AND 16 are merely re-enactments of Sections 2339 and 2340, Revised Statutes of the United States, dealing with the question of vested rights in the use of water on the public domain for mining and other purposes; and providing that all patents granted shall be

subject to any accrued water-right, or rights to ditches or reservoirs used in connection with such water-rights.

SECTION 17 re-enacts Section 2343 of the Revised Statutes of the United States, which authorizes the President to establish additional land districts whenever he may deem the same necessary for the public convenience.

SECTION 18 relates to land and shoal water between low and mean high tide on the shores, bays, and inlets of Bering Sea, within the jurisdiction of the United States, and declares the same to be subject to exploration and mining for gold and other precious metals, under such reasonable rules and regulations as the miners in organized mining districts may make governing the temporary possession thereof for exploration and mining purposes.

We express no opinion on this subject, leaving its discussion to those who are more intimately interested in the development of these distant lands.

SECTION 19 re-enacts Section 2346 of the Revised Statutes of the United States, which provides that land grants to railroad corporations in aid of railroad construction, shall be so construed as not to embrace mineral lands, which are reserved to the United States.

SECTION 20 re-enacts Section 910 of the Revised Statutes of the United States, relating to possessory actions, and provides that no such action in any court of the United States shall be affected by the fact that the paramount title to the land is in the United States, each such case to be adjudged by the law of possession.

SECTION 21 re-enacts the provision of an act of February 24, 1909 (35 Stat. at large p. 645), relating to the return of excess payments made to cover cost of work performed or to be performed in the offices of the United States Surveyor General.

SECTION 22 provides that where, by special act of Congress, land has been opened to exploration under the mineral-land laws but subject to any special limitation or condition expressed in such special act, the Arentz Bill shall not be construed as waiving such limitation or conditions.

If Congress passes the Arentz Bill this provision is proper and appropriate.

SECTION 23 would make land chiefly valuable for building stone subject to location under the Arentz Bill, instead of under the placer law, which latter law would be superseded by this proposed new legislation.

If the Arentz Bill is enacted, this provision would be proper.

SECTION 24 provides that the provisions of the proposed Bill shall not apply to public lands in the States of Michigan, Wisconsin, Minnesota, Missouri, Kansas, or Alabama. In these States the present Federal Mining Law is not in force. Mining lands there have either been disposed of under special acts of Congress or under the agricultural land laws.

SECTION 25 is the repealing section. It sweeps away our present mining law.

IN CONCLUSION the present mining law has been in operation for a long period of time, during which doubtful provisions thereof have been judicially construed with the result that now most mining men have a fairly accurate knowledge of what steps must be taken in order to perfect a valid location and obtain title to the lands embraced therein. We are of the opinion that the enactment of a new or revised code of mining law would cause confusion and uncertainty and lead to much litigation. And in this way we believe the good results hoped for by the proponents of the Arentz Bill would be greatly outweighed by the evils suggested above. In other words, by a repeal of the present well understood law we would be surrendering something of great practical value for something whose utility remains to be demonstrated.

In view of the confusion and litigation likely to result from the proposed revision, and also in view of the fact that among practical mining men there seems to be a feeling that with the change of the time for the performance of annual assessment work from the calendar to the fiscal year, and with the elimination of the 'apex' feature, the present law would give results quite satisfactory, we believe it would be better to repeal the present law relating to extra-lateral rights, adopt a provision fixing a more satisfactory mode of marking boundaries, make provision for the recording in the Local Land Office of mining locations, and let it go at that.

ROAD-BUILDING, during the last 20 years, has become one of the largest industries in America. At present it forms the major part of the construction industry. There are now identified with the road industry 80,000 Federal, State, county, township, and city officials, 7000 road-contractors, 2000 bridge-contractors, 1196 manufacturers and dealers in road-building machinery and materials, 7338 firms manufacturing highway transportation equipment, 25,000 civil, highway, and chemical engineers, and 842 national, State, and local highway associations, and engineers' and contractors' organizations. There are 206 firms manufacturing portland cement for road-building, with an annual output of 125,000,000 bbl., valued at $375,000,000, and total capital of $366,914,110. The dealers in crushed stone number 380, with an output of 9,700,000 tons for road purposes, annually, that is valued at $9,500,000. The capital invested in this branch of the industry totals $27,900,000. Asphalt manufacturers number 42, with an annual production of 1,000,487 tons, valued at $44,610,000, and total capital of $126,000,000; 340 firms producing annually 23,000,000 tons of sand and gravel of a total value of $13,000,000 and having a grand total of invested capital amounting to $9,130,000 are involved in the road industry. In addition there are 2000 firms manufacturing 300,000 commercial cars, valued at $400,000,000, and 165,000 tractors, valued at $225,000,000. In 1919 approximately $400,000,000 was spent on road-construction in this country; in 1920 about $600,000,000; and it is estimated that for 1921 approximately $800,000,000 will have been spent. For next year nearly one and one-half billion dollars is available for road-construction, and it is expected that actual cash expenditures for work of this character will pass the billion-dollar mark.

Concentrating an Ore of Wolfram, Bismuth, and Molybdenite in Australia

By H. W. Bowater

*The old mill erected by the Irvinebank company consisted of 10 stamps, each of 850 lb., a rock-breaker, a Harz jig, two Krupp tables, two Luhrig vanners, three sand-pumps, one mixer, six flotation-cells, and the necessary settlers. Power was supplied from a small colonial-type boiler. The ore was carted to the mill and fed by hand into the rock-breaker; the broken product was elevated into the battery-bins and fed into the mortar-boxes, the pulp passing to a classifier, the underflow from which went to jigs, tables, and vanners, the overflow to settlers. After the removal of a bismuth-wolfram concentrate, the pulp was pumped to the flotation plant, where the molybdenite was recovered. The erection of the first unit of the new mill was started in August 1917, and milling and concentrating began in February 1919. The ore is quartz, in which the rich minerals occur in lumps and patches. Between the quartz and the granite there is a transition zone, through which the molybdenite is evenly distributed. The principal minerals are molybdenite, wolfram, metallic bismuth, bismuth sulphide, bismuth carbonate, and, rarely, a little scheelite. The wolfram is friable; care must be taken to slime it as little as possible, and to crush the molybdenite as much as possible.

MILL. The ore from the mines is delivered by a rope-tram into a bin, passing from this over a grizzley with 2-in. openings. The oversize goes to a jaw-crusher, set to break to 2½ in. and thence to a second grizzley, with 1½-in. openings, the oversize from which passes to a second crusher, set to break at 1½ in.; it then joins the fine material from the two grizzleys, the whole passing to an intermediate bin. From here the ore is trammed to the battery-bin, side-tipping trucks of 1-ton capacity being used. At present the first unit of 20 stamps is in operation; these are arranged in groups of five to each box. The ore is fed by means of Challenge feeders. The stamps, of 1250 lb., drop from 6 to 7 in. at a frequency of 100 per minute. The depth of overflow is maintained at 10 in. Woven-wire screens are used, with an aperture of 1/10 to 1/12 in., the latter for ore rich in molybdenite. The duty varies from 5.5 to 5.8 tons per stamp per 24 hours.

The mortar-boxes are set on concrete foundations with a ⅝-in. rubber sheet between box and concrete. The pulp is automatically sampled before passing to hydraulic classifiers; one classifier is used for each five stamps. The underflow from each classifier passes to a settler, the overflow from all pasing to another settler; the overflow from the last is divided and passes to two more settlers. The underflow from each of the *B* settlers (see flow-sheet) passes to Wilfley and Buss tables, one table being provided for each settler. The overflow from these settlers passes to a large settler, *D*, the underflow of which passes to a Wilfley table. The overflow of settler *D* passes to a still larger settler *E*, the underflow of which is sent to No. 2 Group of hydraulic classifiers.

Three products are made by the concentrating tables: bismuth-wolfram concentrate, middling, and tailing. The concentrate assays 30 to 45% tungsten trioxide, and from 5 to 7% bismuth. The middling assays about 8 to 10% tungsten trioxide, 5% molybdenite, and contains a moderate percentage of pyrite. The tailing contains from 0.1 to 0.13% of tungsten trioxide, the amount of molybdenite varying according to the degree of fineness attained during crushing. The concentrate is sent to the drying and magnetic-separation room; the middling goes to Wheeler pans, thence to hydraulic classifiers, the underflow of which passes to Krupp tables, producing bismuth-wolfram concentrate, middling, and tailing. The concentrate, assaying from 25 to 40% tungsten trioxide, and from 3 to 5% bismuth, is sent to the drying and magnetic-separation room. The middling from the Krupp table is elevated back to the Wilfley table dealing with the underflow from the settler *D*. The overflow from the classifiers passes to a settler *F*, the underflow of which goes to an Isbell vanner, producing a bismuth-wolfram concentrate and a tailing. The concentrate, containing from 15 to 25% tungsten trioxide, and from 3 to 4% bismuth, is sent to the drying and magnetic-separation room. The overflow passes to two settlers *G*. The underflow of this, together with the overflow of the settlers *C* and *CA*, passes to two classifiers (No. 2 Group), the underflow of which passes to an Isbell vanner, the overflow going to settlers *G*.

The tailing from the Wilfley and Buss tables is passed to two settlers *CB*, the underflow of which is sent to the molybdenite-flotation plant, the overflow being pumped back to the mill-reservoir. The tailing from the Krupp tables and the vanners is passed to a settler *H*, the underflow of which is passed to the molybdenite-flotation plant, the overflow going to the creek dam. The underflow of settler *G* goes to slime-frames, producing a low-grade concentrate and a tailing, the overflow going to the waste settler *L*. The tailing, together with the underflow of settler *H* passes to the molybdenite-flotation plant.

The underflow of settler *K*, together with No. 2 concentrate from the slime-frame is treated on buddles and a Luhrig vanner, producing bismuth-wolfram concentrate, middling, and tailing. The concentrate is sent to the

*Abstracted and condensed from the proceedings of the Aust. I. M. M.

drying and magnetic-separation room; the middling is returned to the vanners, and the tailing is sent to waste.

Treatment of Bismuth-Wolfram Concentrate. The bismuth-wolfram concentrate is dried, sampled, weighed, and assayed; it is then sized into three grades (through 30 mesh, through 16 mesh, and through 12 mesh) and treated magnetically. Any oversize is crushed and resized. Two magnetic separators of the Dalbouze bracket type are used, with current at 110 volts. The product from the separators is a clean wolfram concentrate, and a bismuth concentrate containing a little wolfram. A small amount of iron is also obtained, which contains a low percentage of wolfram; this is dressed on a Wilfley table, producing a fairly high-grade wolfram concentrate, which is shipped.

Molybdenite-Flotation Plant. Each unit of the molybdenite-flotation plant consists of two sub-units (see Fig. 2); No. 1 deals with the tailing from the Wilfley and Buss tables, and No. 2 deals with the tailing from the Krupp tables, from the Isbell vanners, and from the slime-frames. The underflow from settlers *CB* (see Fig. 1) is passed to settlers of the cone type. The dewatered pulp is passed to a mixer, where the necessary oil is added. From the mixer the pulp is fed to distributors. The flotation-cell is of the cone type, 4 ft. 9 in. diam., and 3 ft. 3 in. deep. The distributor occupies 1 ft. 11 in. of the centre of the cell, leaving 1 ft. 5 in. of the outer diameter as the flotation area. The underflow of the No. 1 flotation-cells passes to distributors on the No. 2 cells, the concentrate going to a dewaterer. The underflow of No. 2 cells is sent to two large settlers, the liquor overflowing to the storage reservoir, and the tailing passing to waste, the overflow combining to provide the water necessary for flushing the pulp.

The concentrate from the No. 2 flotation-cells combines with that produced in the No. 1 cells and passes to a dewaterer. The overflow from the two cone-settlers is passed to a large settler *J*, the underflow of which is sent to No. 2 sub-unit, the overflow passing to a still larger settler *K*. This precaution is taken to prevent trouble in case of the overflow of the two cone-settlers, and to obtain a better settlement of the fine material.

The tailing from the Krupp tables, from the Isbell vanners, and from the slime-frames, and the underflow from settler *J* are all sent to a large settler *L*. The underflow from this is passed to two cone-settlers, the overflow going to waste. The dewatered pulp from the cone-settlers is then dealt with as in the No. 1 Sub-unit, the feed from the mixer passing to a set of three flotation-cells, the concentrate going to the dewaterer.

The molybdenite dewaterer is a rectangular box, 3 ft. long by 2 ft. wide and 6 in. deep. On the bottom of the box is an 80-mesh screen. The pulp is delivered to the box, the latter being given a shaking movement. The dewatered concentrate is removed periodically from above the screen, the liquor and the fine molybdenite passing through the screen into a large 3-compartment box. The fine material settles in this box, the liquor overflowing to the storage-reservoir. The fine molybdenite in the first compartment of the box is removed periodically and dressed, to a marketable concentrate, in keeves. The product from the second and third compartments, together with the skimmings from the keeves, are returned to the mixers. As much as possible of the liquor is saved and pumped from the storage reservoir to tanks that are

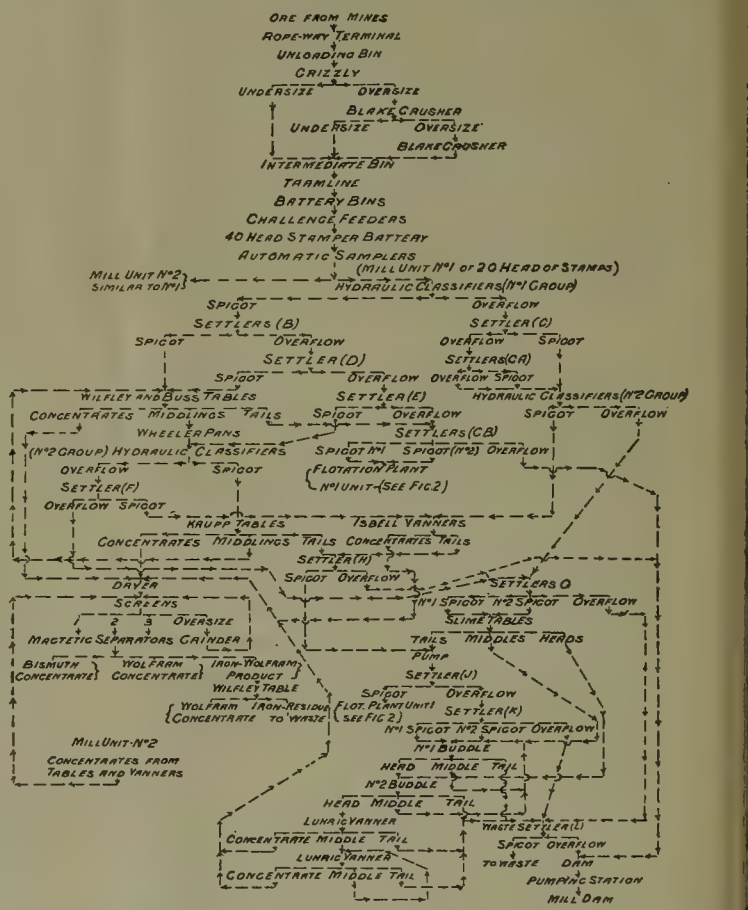


Fig. 1. FLOW-SHEET

placed above the mixers, thus providing liquor for the mixers and sufficient overflow for the flotation-cells. The dewatered molybdenite concentrate is dried and is then ready for the market. That obtained from above the screen assays from 85 to 94% molybdenite. The dressed concentrate from the first compartment of the box assays from 80 to 85% molybdenite, the purity depending on the cleanliness of the water used in flotation and the nature of the ore.

Laboratory Control. Mine- and battery-samples are assayed for tungsten, molybdenum, and bismuth, as is an average check sample that is weighed from the daily

pulp-samples, in amount proportioned to the tonnage crushed. The bismuth-wolfram concentrate from the Wilfley and Krupp tables and the vanners is assayed for tungstic acid and bismuth. The molybdenite concentrate is assayed for molybdenite, with a check for insoluble. Separated wolfram or bismuth concentrate is assayed for tungsten and bismuth; the acid method is used on all samples analyzed for tungstic acid; mine- and battery-samples are analyzed colorimetrically for both molybdenite and bismuth. The bismuth in the concentrate is determined by gravimetric methods, using the acid solution from the tungsten test. Occasionally a gravimetric test is made for molybdenum and bismuth in the mine- and battery-samples.

The following methods are used in the chemical laboratory:

Method of Estimation of Tungsten Trioxide in Concentrates and Ores. It is most important that the ore be finely ground. Treat 0.5 gramme of the concentrate with 60 cc. of hydrochloric acid, having the beaker covered with a watch-glass. Digest for from 2½ to 3 hours, with further additions of acid as the solution evaporates. Add 25 cc. of concentrated nitric acid, and evaporate to about 10 cc. It is best not to heat to dryness, as there is danger of overheating the residue and causing the tungstic acid to become insoluble in ammonia. Take up the residue with 50 cc. of hot water and allow to stand for 3 hours. Filter and wash well with hot water. The residue in the beaker is now treated with about 50 cc. of ammonium hydrate (1 to 1), to which 1 cc. of strong hydrochloric acid has been added. The solution is filtered, then transferred to a weighed procelain dish and evaporated to dryness. The dish is then heated (gently at first) to expel ammonium salts, and the residue is weighed as tungsten trioxide.

Colorimetric Estimation of Bismuth. Weigh 0.05 gm. of finely ground ore for 3% bismuth or over, or 0.5 gm. for ores containing under 3%; transfer to a 500-cc. graduated flask, add 25 cc. nitric acid, and 75 cc. water, and boil for 10 minutes; cool, fill up to the mark with water, mix thoroughly, and filter about 100 cc. into a dry flask. Fill a burette with the solution, which is now ready to compare with the standard solution of bismuth. Fill a similar burette with standard bismuth solution, add exactly 1 cc. to a 50-cc. Nessler tube, together with 10 cc. of a 10% solution of potassium iodide, and three drops of sulphurous acid. To a second Nessler tube add 10 cc. of potassium iodide solution and three drops of sulphurous acid, and then add the sample until approximately the same depth of yellow is obtained in the standard tube; then read the burette. If the reading were 5 cc., and if 0.5 gm. of ore had been taken, the result would be 10% bismuth.

To prepare the standard bismuth solution, weigh 0.025 gm. of pure metallic bismuth; transfer to a 500-cc. graduated flask, add 25 cc. of nitric acid and 75 cc. of water. Boil gently for 10 minutes, cool, make up to the mark with water and mix; 1 cc. of this solution equals 0.00005 gm. of bismuth. In calculating, divide the 500 cc. by the number of cubic centimetres consumed of the sample, and multiply by the value of 1 cc. of the standard; this multiplied by 2000 will give the percentage.

Colorimetric Estimation of Molybdenite. Weigh 1 gm. of the finely ground ore and treat with aqua regia. The solution is evaporated repeatedly to small bulk with nitric acid, and then evaporated to a pasty consistence. Add 30 cc. water and 10 cc. hydrochloric acid, warm, stir until clear; add 15 cc. of ammonium hydrate and boil for a few minutes; filter into a 250-cc. flask, wash the precipitate on the filter with hot water, make the solution just acid with acetic acid, then add 10 cc. strong acetic acid in excess; cool, make up to the mark, and mix. The solution is now ready for comparison with a standard ammonium molybdate solution.

The standard ammonium molybdate solution is made by adding 2 cc. of ordinary molybdate solution, as used

Fig. 2. Flow-sheet of molybdenite-flotation unit

for estimating lead (9 gm. per litre), to a 250-cc. graduated flask; add 20 cc. of hydrochloric acid, 30 cc. of ammonium hydrate, and boil for a few minutes, to obtain approximately the same conditions as in the sample. Make just acid with acetic acid, and add 10 cc. in excess; cool, make up to the mark, and mix. Make up a fresh solution of tannic acid, 0.5 gm. to 100 cc., and fill a burette with the standard solution, a second with the sample, a third with the tannic acid; add 2 cc. of standard solution and 2 cc. of tannic solution to a 50-cc. Nessler tube; dilute to the mark, and mix gently. To a second Nessler tube add 2 cc. of tannic acid, then add the sample solution until the same color is obtained. The value of the standard molybdate solution is calculated as follows: The ordinary solution is usually standardized against 0.3 gm. lead sulphate, which consumed, say, 20 cc. of it; 0.3 gm. lead sulphate is equal to 0.1584 gm. molybdenite; therefore, 2 cc. is equal to 0.01584 gm. molybdenite. This is the total value of the 250 cc. kept as the standard; 0.01584 divided by 125 gives the value of 2 cc., the amount used in the Nessler tube for comparison, that is, 0.0001267 gm. molybdenite. Thus if 8 cc. of the sample prepared from 1 gm. ore were consumed, the result would be 0.39%

molybdenite; 2 cc. is chosen as giving a convenient color, and maintained as far as possible for convenience in memorizing. This method is the one suggested by G. Spurge and has been found to give good results with low-grade ore, battery-pulp, and tailing.

Estimation of Bismuth in Bismuth-Wolfram Concentrate. The wolfram is estimated as previously shown. The filtrate, after filtering the tungsten trioxide, is evaporated to small bulk, and the nitric acid is expelled by the addition of hydrochloric acid and by boiling. Owing to the absence of lead in the concentrate, no sulphuric acid is required to convert this into lead sulphate. Dilute the solutions and saturate with sulphuretted hydrogen. Bismuth, together with arsenic, antimony, molybdenum, and other metals, is precipitated as the sulphide. Filter and wash thoroughly with hot water. A hot solution of potassium cyanide is then passed through the precipitate, when the impurities are dissolved, leaving the bismuth sulphide undissolved. Wash with hot water, dissolve in nitric acid (1 to 1), dilute a little, and boil. Partly neutralize the solution, but without producing any permament precipitate, and then add a solution of ammonium carbonate in slight excess. Allow the solution to stand on the hot plate for some time and until the bismuth carbonate has settled. Filter and wash with hot water; dry the precipitate and ignite in a weighed porcelain crucible, first removing the precipitate from the filter-paper, which is burned to an ash, then add the precipitate. Ignite at a low red heat, cool, and weigh as bismuth trioxide (Bi_2O_3).

Volumetric Estimation of Molybdenite. One gramme of the ore is weighed and treated with nitric acid and a little hydrochloric acid, the molybdenite being converted into molybdic acid. The solution is evaporated repeatedly to small bulk with nitric acid, and then evaporated to a pasty consistence. The residue is extracted with ammonium hydrate, the solution is boiled, then filtered, the residue being washed with hot water. The solution is made up to 250 cc., and mixed thoroughly; 20 cc. standard lead sulphate solution (measured from a burette) is acidified with acetic acid, diluted to 100 cc., and boiled. This solution is then titrated with the assay solution until a faint yellow tinge is obtained, using tannic acid solution as indicator. On the basis of 1 gm. taken, the reading obtained less 0.2 cc. divided by 1978.75 gives the percentage of molybdenite. The standard lead sulphate is prepared by weighing 7.5 gm. of pure dry lead sulphate; take up with 400 cc. of ammonium acetate (slightly acid with acetic acid), and dilute to 1 litre. When dealing with rich molybdenite concentrate take 40 cc. of lead sulphate solution instead of 20 cc.; note reading, deduct 0.2 cc., and divide by 2 before dividing into 1978.75. The filter-paper containing the insoluble can be dried, ignited, and weighed as a rough check against the figures, the addition of percentage of insoluble and molybdenite giving about 99%.

The production of zinc in France has decreased 80% since 1913, largely because of the high cost of coal used for smelting.

Vanadium

*Del Rio, in 1801, discovered vanadium in ore from Mexico, and named it erythronium; but later, when his conclusions were attacked by others, he became doubtful of his own work, and decided that erythronium was merely impure chromium. Sefstrom, in 1930, while examining a piece of peculiarly soft iron smelted from the Taberg iron ores, suspected the presence of a new element, and believed that the slag from the smelting of these ores should contain it. From this slag he succeeded in isolating the new element which was named after Vanadis, a surname of the Scandinavian goddess Freya. The principal vanadium minerals mined as ores of this metal are patronite, roscoelite, vanadinite, and carnotite.

According to Emmons, several water-soluble compounds of vanadium are known to occur in nature, and the metal could have been transported in the form of any of them. Vanadium was at one time considered a rare element, but it has been found to be widely distributed. In spite of this fact, deposits of vanadium sufficiently rich to be of commercial value are not common. The metal has been found in several European iron ores, in the Permian beds of Germany and Russia, and in the copper deposits of Russia and of Cheshire, England. The last mentioned deposit was at one time of exploitable value. The bauxite deposits of France also contain vanadium.

Patronite is known to have been found in commercially important amounts only in the Minasragra district in Peru. There, according to Hewett, the mineralis found in red shales that have been cut, at the point where the orebody occurs, by a quartz-porphyry dike. At least four distinctly different dike systems exist in the vicinity. The principal deposit has a lenticular form, and its maximum width and length are 28 and 350 ft. It occupies a fault that has displaced the quartz porphyry. It consists principally of (1) a lustrous black hydrocarbon called quisqueite, (2) a dull, porous, coke-like mass that is nearly pure carbon, and (3) patronite. It appears that after the quisqueite and coke-like material were solidified in the fault-fissure, further movement sheared and crushed them and the enclosing shales, and that then the patronite filled and solidified in the cavities thus formed or previously existing in the carbonaceous mass. Veinlets of quisqueite and patronite have also invaded the country rock, and the latter has in some places, especially along the hanging wall, been impregnated to saturation with patronite. At the surface the patronite has been altered to red and yellow oxides of vanadium and a green iron vanadate which almost entirely replace or fill cracks and fissures in the shale. Nickeliferous pyrite and other impurities exist in the main lode which contains about 10% of vanadic oxide, whereas the roasted ore averages between 35 and 40% of this oxide. An impregnated, hard, blue-black shale on the foot-wall carries 13% vanadic oxide.

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*Abstracted from bulletin No. 115, University of Arizona, by M. A. Allen and G. M. Butler.

Progress in Cutting and Welding With Acetylene

*During the past two years there has been much progress in welding and cutting by means of acetylene. Although in most cases improvements have not been radical, they have been of such a nature as to make the apparatus more reliable and successful in operation, which has resulted in the process becoming safer and more economical. The theory of the operation of torches has become better understood, with the result that back-firing has decreased, lessening one of the annoyances in the operation of the equipment.

There has been a general increase in the application of the processes. Not the least notable accomplishment was that of the manufacturers of welding-gases, who maintained prices during and after the War at little above pre-war figures. This has enabled gas-welding to compete in many cases with electric welding where otherwise, on account of low cost, the latter might have been used. While there has not been any special increase in the size of pieces welded, there has been an increase in the number of such pieces, due to the better education of those doing the work, and to the demonstrated success of large and difficult jobs previously done. Acetylene-welding is coming to be recognized as a safe method of construction and repair when in the hands of good designers and skilled workmen. There has been much discussion of welding large storage-tanks for oil and sundry vessels subject to pressure. Designs have been prepared for storage-tanks having a capacity of 5000 bbl., while somewhat smaller ones actually have been constructed and have proved their worth in service.

A 'Code' has been prepared for regulating the construction of pressure-vessels by a conference committee on which your Association was represented. This Code has been presented to the Boiler-Code Committee of the American Society of Mechanical Engineers for their consideration, and in due time it will doubtless be a strong factor in the production of safe welded pressure-vessels. This is probably the most important development that has taken place during the last two years.

The welding of pipe-lines has been extended greatly, as it has been found that welded joints are more reliable than any other joint, and probably cheaper than any other satisfactory joint for permanent construction. In one instance an eight-inch pipe-line under heavy pressure, was tested at 1000-lb. pressure, hydrostatically, and the welds were hammered with a sledge at that pressure. This test has been found successful in detecting defective welds. The method is not new in some other fields, as for instance in the testing of cast-iron and lap-welded pipe, but its application to welded construction generally is recent. Apparently it is just as effective as in tests for the older methods of joining.

Study of the problem of welding alloy-steel indicates that metal of almost any desired composition can be deposited with the oxy-acetylene torch, but that there are many important problems like pre-heating, heat-treatment, and annealing to be considered. Duriron, which is a high-silicon cast-iron, is being successfully welded, but must be most carefully pre-heated. Manganese-steel is difficult to work, but good results are being obtained on simple castings. The welding of alloy-steels which are used where great strength is required, does not offer much promise, unless the metal can be poured and heat-treated. Nickel-steel, chromium-steel, and vanadium-steel are splendidly welded, but as welds are almost always made where great strength of metal is needed at a point of maximum stress, further research in this direction is of importance. Monel metal has been welded satisfactorily for making containers for acid. Monel metal is also used for valves and other specialty work, and welding is being studied in this connection.

Oxy-acetylene welding is considered by many users of all forms of welding, to be better in quality than electric-arc welding. Where especially high-quality welding is required and severe tests are to be passed, oxy-acetylene welding is being used almost to the exclusion of the electric process. When welding by the oxy-acetylene process a single butt-weld is considered the best practice; if properly made such a weld will give complete satisfaction for any gauge of metal from the lightest to more than an inch in thickness. Latest practice in electric-arc welding advises a lap-joint, thus making two welds; or the covering of a butt-weld by a double lap-welded strap. This latter practice is undoubtedly based on the lack of ductility of electric-arc welds, and means are, therefore, taken to keep the stress off the essential butt-welds. This means three electric welds to one by oxy-acetylene, besides entailing the use of extra material.

Oxy-acetylene cutting has been in severe competition with cutting by oxygen used with various fuel-gases. It has been determined that a large part of this competition has been due to the difficulties of obtaining compressed acetylene during the War and immediately afterward. The efficiency of acetylene for this work is being more and more recognized. Heavy cutting is a field where the process has been limited by the inability of equipment to supply sufficient oxygen. Some interesting heavy cutting has been done by using special knowledge of the need for oxygen. In one case 27 ft. of 15-in. steel was cut in removing the hollow circular riser of an enormous casting. Two regulators were connected on the reduced-pressure side, and the oxygen was led through a large hose to the torch. At the Philadelphia Navy Yard, five regulators were connected to a common low-pressure pipe, 2 in. diameter; an air-hose was used to carry the oxygen to the blowpipe, which had a specially large tip. The oxygen-bore was $\frac{1}{4}$ in. diameter. By this means and by

*Report of the Oxy-Acetylene Welding Committee at the annual convention of the International Acetylene Association in New York in October 1921.

increasing the oxy-acetylene pre-heat a little, beautiful cuts 24 by 24 in. were made. Oxy-acetylene cutting has been much used for constructive work during the past two years. Forgings have been trimmed practically to dimension, and in some cases cutting has been so developed that intricate shapes such as connecting-rods are being cut out with the oxy-acetylene torch.

Cutting cast-iron is an extremely interesting development of the past several years. The fundamentals of the process seem to be that a large excess of pre-heat must be used, so that the cast-iron is heated to a red temperature over a considerable space. A large and powerful oxygen-jet is then directed on the red-hot cast-iron, with the heavy pre-heat still applied. The kerf made in the iron casting is quite similar to that made in the cutting of steel, except that the width of the kerf is generally double that in a steel casting of similar size, and is not quite so clean looking. It is easy to see that more gases are used than in similar steel cutting, and it has been noted in tests that the time for cutting is about double that for steel; therefore, cast-iron cutting is three or four times as costly as steel cutting, and in most work it can hardly be said to compete with saws. There are, however, many places where heavy chamfer cutting is to be undertaken and a couple of welders are standing by. Normally the cast-iron would be 'V'd' out by a laborer with compressed-air driven tools, and probably a day or two would be required for preparing a large job. Although cutting by torch is more expensive than is the actual preparing of the work by compressed-air tools, it is certainly economical in the above case, when we consider that two operators must stand by, thereby accumulating an expense of $10 to $15 per day each.

An interesting and valuable use of oxygen is the burning of holes into salamanders in blast-furnaces, to permit the insertion of the dynamite used in breaking them up. A similar process is used in opening furnace tap-holes. This is done by heating the point at which the hole is desired to a red heat and directing against it a steel pipe, through which oxygen is passed under a heavy pressure, often up to 250 lb. The burning of the steel pipe brings the cast-iron to a temperature for the oxygen to combine with it. Of course, the steel pipe is gradually burned away; but the hole may be made of almost any depth by supplying sufficient pipe and oxygen.

Oxygen manifold and pipe-line installations have been recommended together with the use of cylinder platforms. The use of platforms enables cylinders to be unloaded from trucks and re-loaded without a large crew of laborers being called. Simplifying the problems of handling cylinders helps to stabilize the industry by removing an annoyance. In large installations for welding and cutting, such as are found at some of the steel-mills, improved means of handling oxy-acetylene tanks and carbide have been introduced, and safety rules provided for their storage and handling. These improvements and rules not only have resulted in rendering the process more economical, but they have decreased accidents. Safety rules should be advocated by all interested in the acetylene process and their adoption should be urged upon all users regardless of the size of their work. One of the interesting developments is the use of automatic machines for welding tubing from strip steel, the product being equal to seamless tubing and costing much less.

The problems confronting our industry are many and varied. It is gradually being discovered that welders cannot be made in six weeks, except for the simplest operations; and, while there is not yet complete agreement as to the best methods for training welders, ideas are being gradually crystallized and the condition will improve rapidly as soon as those vitally interested appreciate the need of proper and thorough training, not only in the actual handling of the apparatus, but in the fundamental principles involved. When this time comes, welders will be selected intelligently instead of haphazardly, as is too often done at present. Your committee urges on the members who are interested that they give this phase of our problems special attention.

During the last two years considerable progress has been made in the study of the fundamental problems of gas-welding, such as the best quality of welding-wire, the necessity for satisfactory quality of steel plate for welding, and other problems which are strictly research matters. Such problems cannot be solved in a short time. There are many factors involved, not the least of which is the necessity of proving to those who make the wire and plate that their product must be of satisfactory quality aside from its chemical composition, if good welding is to be secured. Already progress has been made in this direction, but much remains to be done. Your committee hopes that active co-operation of the members may be secured in furthering these important matters.

Research on the proper composition of welding-wire seems to show that ordinary straight carbon-steel is not the best metal for the purpose, but that alloy-steel of the proper composition should be used if the best results are to be obtained. This is important and the subject requires a large amount of experimenting, but there is no question that better results may be expected within a reasonable time.

THE superiority of brass pipe is conceded by plumbers on account of the endurance and resistance to corrosion. There are innumerable instances on record where iron pipes after three or four years service have been found so filled with rust that an ordinary lead-pencil could not be passed through them. This rusting, which seems inevitable in iron pipe, will cause leaks not only in the joints where the thread has decreased the thickness of the metal, but at other points of structural weakness. Brass pipe has occasionally failed from 'season cracking'. This defect is due to initial strains in the metal, a condition now understood by manufacturers, and can be eliminated by a suitable relief anneal. In concealed piping, where costs of repairs are necessarily heavy on account of tearing out walls and floors, iron pipe should never be installed.

$60,000 ROBBERY AT THE ARGONAUT MINE IN CALIFORNIA

Six men armed with sawed-off shotguns blew open the safe of the Argonaut mine at Jackson, California, early on the morning of December 1, and escaped with more than $60,000 in gold amalgam in two automobiles driven by two others who had acted as lookouts during the robbery.

George W. Lucot, sheriff, was on the road about an hour afterward with a posse, searching in the direction of Cone, following a report that the robbers had headed out of the Mother Lode into the San Joaquin valley. The loot was a month's clean-up for the mine. Its weight was 455 lb., and the robbers apparently were aware of the fact that the mine's plates had just been scraped preparatory to melting down bullion for shipment. The amalgam was in the form of balls.

The two millmen on duty, Reese Williams and James Podesta, were overpowered and bound with ropes, but Williams managed to back up against an emery wheel afterward and rubbed the rope in two. He then released Podesta, but they found the bandits had cut the telephone wires at the mine and so they were delayed in giving the alarm. Red bandana masks were worn by the men, whom the millmen said were well dressed and apparently familiar with the mine's operations. The mine is owned by the Argonaut Consolidated Mining Co., of which John T. Smith of New York is president.

FEDERAL TAXATION OF MINES

The revised tax bill as approved by the President on November 23 provides that all gold-mining companies be exempted from the excess-profits tax for 1917, whether they have paid the tax or not, and in the cases of those companies which have paid the tax the same will be refunded. The existing law relating to depletion allowance in the case of mines, oil and gas wells, and timber is continued, but the depletion allowance based on discovery shall not exceed the net income from property upon which the discovery is made except where such net income is less than the depletion allowance based on cost or fair market value as of March 1, 1913. The war-profits and excess-profits taxes are repealed, effective January 1, next, and the maximum surtax rate is fixed at 50%.

RUMOR OF CONSOLIDATION OF MICHIGAN COPPER MINES IS DISCREDITED

Nothing is known at Houghton of the report, emanating from Duluth and published in newspapers, to the effect that "most of the big copper mining companies operating in the Lake Superior district will be consolidated some time next year with the Calumet & Hecla Mining Co. as a nucleus". Local mining men state they are without knowledge of any project of that kind. It is pointed out in the Duluth report that "operating costs of mines in the Lake country are so high compared with companies mining 'disseminated' ore in other sections of the country that it is important that they be brought down to much lower levels. In addition to high material prices and labor, greater depths of the mines and decreasing grade of ore have increased costs. Great economies, it is added, could be had by centralization".

There is not so much to this argument as might appear on the face of it, mining authorities there point out. The only big properties not now in control of Calumet & Hecla are the Copper Range, Quincy, and the Stanton mines. It is not believed that a consolidation including these properties would work for lower costs, inasmuch as they apparently have costs down to the minimum. All are well equipped and each has effected great economy in operation. Labor costs vary but little and one company buys fuel and materials as cheaply as another. In mining, milling, and smelter practice the most modern methods are employed and the problem of costs has been attacked in every possible direction. This generalization will be found to be true upon analysis. Those who should know merely dismiss the reported consolidation as something without foundation in fact.

U. V. X. APPEALS FROM DECISION IN SMELTER-SMOKE SUIT

The United Verde Extension Copper Co. has appealed to the Arizona Supreme Court at Phoenix from a judgment against it of $1 and costs secured in Yavapai county by two Verde Valley farmers, David H. Biles and S. P. Wells, who said they had been injured by the fumes of defendant's smelter to the extent of $2557. The costs of the case amount to $1620.

CALIFORNIA MINING BUREAU ISSUES ITS ANNUAL REPORT

The California State Mining Bureau announces the issuance of its Seventeenth Annual Report. In spite of the depression and inactivity of some branches of the industry, the annual value of more than 50 mineral products of California shows a production of a quarter of a billion dollars. The Report is attractively bound in cloth, comprising 600 pages; it may be secured by addressing the State Mining Bureau, Ferry Building, San Francisco, or any of the district offices of the State Mining Bureau. The price of the publication is $1.75, including delivery charges.

TONOPAH EXTENSION COMPANY BUYS CASH BOY MINE

The Tonopah Extension Mining Co. of Tonopah announced at Tonopah on December 2 that it had purchased the Cash Boy mine from the Tonopah Cash Boy Mining Co. paying for it 100,000 shares of Tonopah Extension stock which is equivalent to $145,000 based on the market value of Extension stock.

The transaction is one of the most important consummated for some time as it ends litigation involving extra-lateral rights that would probably have extended over an indefinite period. About three months ago the Extension company brought suit against the Cash Boy for $15,000 damages, asserting that it held the apex to ore which the Cash Boy was mining. C. E. Stoneham of New York City is the principal stockholder of the Cash Boy. George B. Thatcher and E. H. Mead, both of Reno, are also heavy stockholders. The Cash Boy was capitalized for 2,000,000 shares and on this basis the Extension gave one share of its stock for 20 shares of the Cash Boy. During the past few

weeks it is reported some exceptionally good ore has been opened in the Cash Boy and it is understood that this showing led to the deal with the Extension through which costly litigation was avoided.

REVISION OF THE MINING LAW

The following resolution has been unanimously passed by the Montana Mining Association:

Whereas, for more than a half century under our present laws the mining industry of this country has developed to its present magnitude, and through physical practice and interpretative court decisions and departmental rulings, our people have become familiar with the laws now governing mining, and,

Whereas, the proposed revisions of the present mining laws contain changes so drastic that they will seriously disturb, retard, and injure mining by reason of such proposed changes, therefore, be it

Resolved, That the Montana Mining Association protests against the passage of this proposed legislation; that its passage will work a great hardship upon the mining industry of Montana, with no resultant benefits whatever, and we respectfully recommend to the Congress that it adopt a "hands-off" policy as affecting the laws governing mining.

Resolved, That a copy of these resolutions be sent to our Senators and Representatives, to the press of the State, and to other mining associations.

The undersigned certify that the foregoing is a correct copy.

C. S. MUFFLY, President.
LEO FAUST, Secretary.

PROVISIONS OF THE NEW ACT ON WAR MINERALS RELIEF

The provisions of the new Act passed on November 23 by Congress are in the form of an amendment to the Act of March 2, 1919. They follow: "That all claimants who, in response to any personal, written, or published request, demand, solicitation, or appeal from any of the Government agencies mentioned in said Act, in good faith expended money in producing or preparing to produce any of the ores or minerals named therein and have heretofore mailed or filed their claims or notice in writing thereof within the time and in the manner prescribed by said Act, if the proof in support of said claims clearly shows them to be based upon action taken in response to such request, demand, solicitation or appeal, shall be reimbursed such net losses as they may have incurred and are in justice and equity entitled to from the appropriation in said Act. If in claims passed upon under said Act awards have been denied or made on rulings contrary to the provisions of this amendment, or through miscalculation, the Secretary of the Interior may award proper amounts or additional amounts".

LABORATORY FOR OIL-SHALE INVESTIGATIONS IS IMPROVED

The U. S. Bureau of Mines announces that the oil-shale laboratory at Boulder, Colorado, has been enlarged and equipment added preparatory to more extensive work on Colorado shales. Important changes have been made in the temperature-measuring apparatus and in the drive-mechanism of the horizontal retort. A new position for the pyrometers in the retort-furnace has been selected. They are expected to indicate more accurately the temperature of the shale in the retort and also make possible more definite control of retorting conditions. During the past two years several attempts have been made without success to classify oil-shales by chemical determinations. It has been suggested that the quality of oil to be obtained from a given shale will be most influenced by the C:H:O ratio in the organic matter. Work is under way seeking to determine this ratio for representative shales. The work involves separation of the organic from the inorganic constituents; elementary combustion analysis of the recovered organic matter; retorting of a sample of the same shale in the assay retorts; and a distillation analysis and chemical examination of the oils produced by the assay-retorts. The work is well under way, although at the start difficulty was experienced in making a clean separation between the organic and inorganic parts of the shale. A method for the separation has been developed, however, that appears satisfactory. Experiments in refining oils produced from Colorado oil-shales have been started.

ARIZONA

Bisbee.—With the payment on December 19 to shareholders of record December 2 of a dividend of 50c. per share, Calumet & Arizona will have disbursed $2 per share this year. It has been able to do this because of the fact that it held something in reserve in its treasury during the 'fat years' when liberal disbursements were made, but which were not quite satisfactory to many of the shareholders at that time. The wisdom of a conservative policy during that period has since been well demonstrated, in the opinion of George A. Newett, one of the directors. The dividends of the present year have not been made from this year's earnings, as is well understood, as no copper has been made since last spring when the company's smelter was shut-down. Several hundred men have been on the payroll since that time, however, this for the main purpose of aiding labor in this trying time. The company has been conducting important development work, repair of shafts and machinery, and will have the property in fine condition when a resumption of mining and smelting is ordered.

Kingman.—A jury verdict of $20,000 has been given in favor of the Wallapai Mining & Development Co. in its suit against the United States Smelting, Refining & Mining Co. et al. The plaintiff was represented by Frank Pierce of Los Angeles and C. W. Herndon of Kingman. Appeal will be taken to the State Supreme Court. The issue was the disposition of an old mill on ground of the Tennessee mine, which had been under lease to the defendant interests. It was not used, the ore mined having been shipped to the smelting company's works at Needles.——The C. O. D. property, which had been closed after resignation of M. B. Dudley as manager, has been started again under charge of Arthur D. Storke. Development work is being continued and there is expectation that milling will be resumed some time in January.——On the 250-ft. level of the Tuckahoe at Chloride has been cut an 8-ft. vein that is said to sample 300 oz. silver. The find is considered one of the most notable ever made in the district. For years the mine has been worked by the lease method and the ore sent to smelters. ——Expensive pumping equipment has been installed at the Kaaba mine, where exploration is being made of an 8-ft. vein of rich gold ore. Diamond-drilling is being performed from the 310-ft. level. The property has its own mill.

Miami.—The Inspiration company is using three shifts in exploration of ground at the old No. 2 Live Oak shaft and is tunneling at the No. 1 Live Oak. A shaft is being sunk just below the old Porphyry shaft. No ore production is contemplated and the concentrator will remain idle for the present. The company has made the second payment on its $1,000,000 purchase of the Porphyry claims, remitting $250,000 on the principal sum and $22,500 interest.

The resumption recently of copper pouring at the International smelter has had formal celebration at a banquet in the Miami Y. M. C. A., arranged by the Miami Rotary Club, the Globe Luncheon Club, and the Miami Boosters' Club. The furnaces had been inactive for seven months. Now employed at the smelter are about 200 men, all of

them former employees, while 300 more are working in the Inspiration mines and offices, on lately commenced activities. These additions to the employed workers have given the camp a relative degree of prosperity.

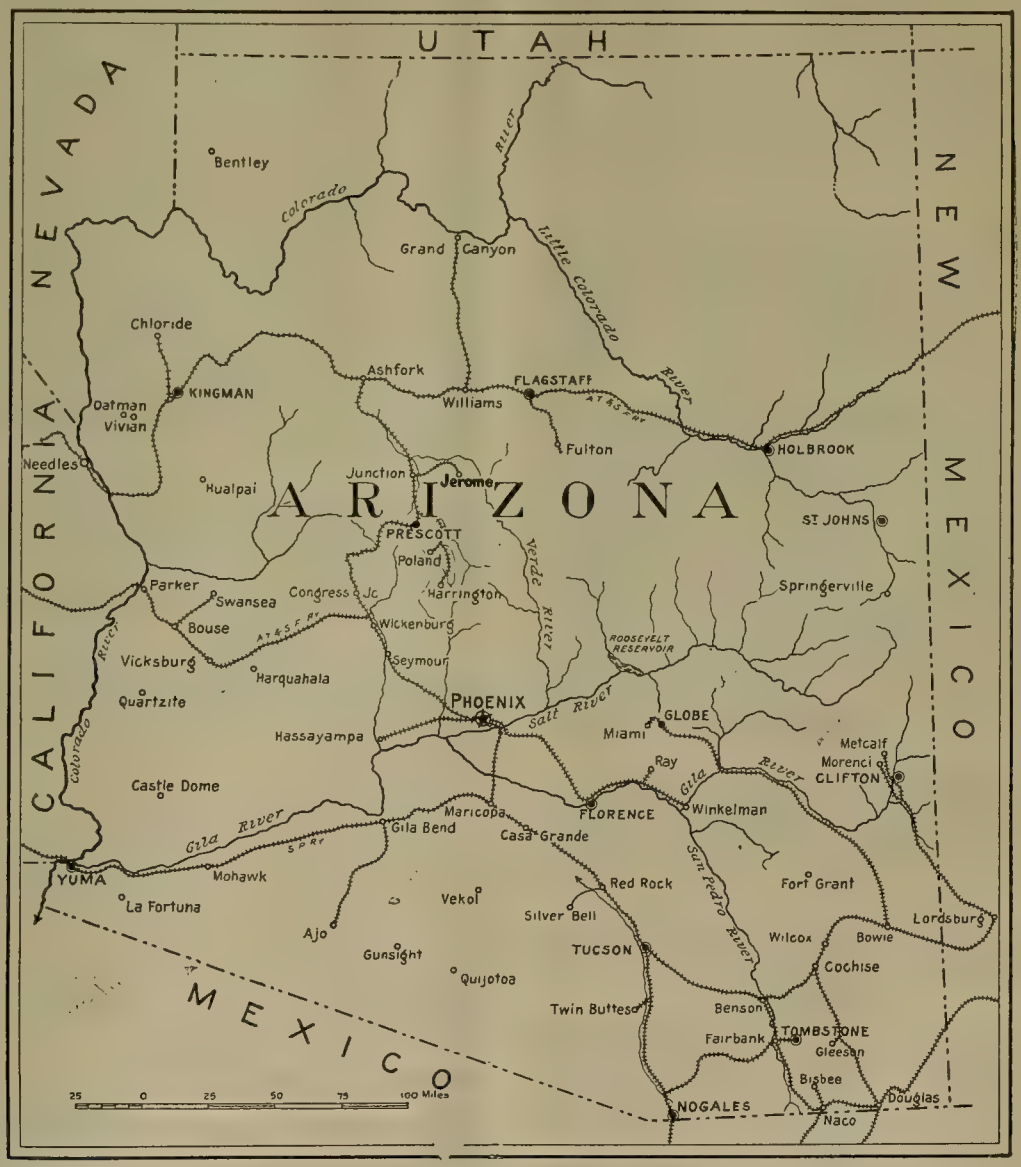
Tucson.—Operations have been resumed at the Yellow Bird mine in the Papago district, 30 miles south-east of here. It will be operated by a company organized by S. W. Purcell of this city. Operation of the Silver Lillie group, 12 miles west of here, under Fred H. Perkins, a mining engineer from Phoenix, is announced. Shipping ore already is available for sacking.——At Pearce the Commonwealth mill is running two shifts per day on Commonwealth ore taken out by lessees.——A few miles north of Christmas, a Gibson mill of 50-ton daily capacity is turning out rich gold-silver-lead concentrate from ore taken from a 2-ft. vein that is being depeloped by three tunnels.

Yuma.—The Arizona Barium Co. is a local organization that is to work a deposit of barite in the Mohawk mountains; plans are made for a leaching- and furnace-plant from which a clinker product is to be shipped to Los Angeles for manufacturing uses.

CALIFORNIA

Downieville.—Definite plans have been made for the reopening of the Oro, the Oxford, the Big Boulder, and the Finney properties.

French Gulch.—The working force at the famous Glad-



Map of Arizona

stone mine was increased recently. All the tunnels and drifts have been cleared and re-timbered, where necessary, to make way for comprehensive development work.

Hayfort.—Alonzo and Lowell Layman have completed the erection of a 5-stamp mill on their gold property. Operations will be commenced at once.

Keddie.—C. R. Leonard and B. H. Smith are obtaining excellent returns from their gravel-mine operations in Butterfly valley. One small pocket recently yielded $600.

Keswick.—The cable for the Mountain Copper Co.'s tramline, from the Hornet mine to Matheson on the Southern Pacific, has arrived. The 32 towers are in place. Stringing the cable on the towers has been commenced. Six mules will be used in dragging the cable to its position on the mountainside.

Masonic.—S. L. Perini has recently uncovered a 3-ft. vein of high-grade gold ore on the Golden Anchor claim. The vein was traced and ore was exposed for a length of 50 ft.; assay returns indicate from $27 to $210 per ton. The mineral belt is an 'andesite formation' which has a width of about 1200 ft. A cross-cut adit was started with two shifts. Perini has a lease and option on the property.

Quincy.—The Jamison gold mine, near Johnsville, which is being operated under lease, will be worked throughout the winter. Sufficient ore is being produced to keep 15 stamps running for three shifts. Good results are being obtained.

Randsburg.—As the development in the district continues, it is noticeable that the best mining machinery is being purchased. The Bray lessees have successfully installed their new 700-cu. ft. compressor, and it is running smoothly, as is their new double-drum hoist. A new cage is on the ground.——The North Rand Silver company is now laying foundations for its electric hoist, compressor, tool-sharpener, and blowers.

Grady & Sill are shipping to the smelter at the rate of a car per day.——The Randsburg Silver Mining Co. is cross-cutting on four levels, 300, 400, 500, and 600 ft. The drift north on the 500-ft. level has advanced 210 ft. on the east vein. The cage is installed and is working satisfactorily. The new assay-office is completed and fully equipped.—— The Silver Moon shaft is down 200 ft.——Erricart and Bernard are cross-cutting at 200 ft. on the K C N lease.

Near the Black Hawk territory, the Gimlet company is drifting, with good indications of silver ore at 50 ft. on the 150-ft. level.——The Black Hawk company has entered the list of gold producers; it has rented the Baltic 10-stamp mill.——The Yellow Aster still keeps 30 stamps dropping. With the Yellow Aster and the Black Hawk steadily producing, it is believed that many of the old mines will be revived.

Rough and Ready.—The Normandie-Dulmaine shaft is being sunk rapidly. Ore is being exposed on the surface. The property is owned by motion-picture actors of Los Angeles.——The recently incorporated Randolph Consolidated Gold Mines is developing orebodies on the old Grant ranch.

Yreka.—W. Howe and J. Hubbard have opened a 2-ft. vein of rich gold ore 12 miles from here on the Shasta river. Development will be undertaken.

COLORADO

Central City.—The Comet tunnel near the Rara Avis mine, within the city limits, has been taken under a three-year lease and bond by Vincent M. Ryan, of Chicago, and M. L. Judge and John Sullivan, of Lincoln, Nebraska. Miners are at work developing a well-defined vein carrying a 6-in. streak of ore assaying from $40 to $50 per ton.

Creede.—The Mid West Mining Co. is installing machinery at the Resurrection shaft; the force of miners will be increased as soon as the plant is in operation. The property has been on the shipping-list for some time. The same company will operate the Mollie S., on Mammoth mountain, this winter and has sent out powder, steel, and supplies.—— A new shaft is being sunk on the Mother Lode mining claim in the Sunnyside district. The vein exposed at surface will be cut by the shaft at a depth of about 50 ft.——Lessees on the Corsair and New York sent out shipments to the Arkansas Valley smelter, at Leadville, and the Durango smelter last week.

Cripple Creek.—Directors of the Cresson Consolidated have been called to meet on Tuesday, December 6, when it is expected the annual report will be ordered issued and action taken on dividends. The mine continues heavy production of from 8 to 10 cars daily, with an average value around $15 per ton.——A series of flat veins has been opened on the Hiawatha, a fractional claim of about 4½ acres adjoining the property of the El Paso Consolidated company on the south. The ore is of shipping grade. The property is operated under lease.——The Golden Cycle M. & M. Co. and the United Gold Mines Co., both controlled by the Carlton interests, will hold directors meeting shortly, when the declaration of a dividend is anticipated.——The Rose Nicol mine, on Battle mountain, is again active under lease; lessees have commenced shipping low-grade mill-ore.

Ouray.—The White Cloud Mining Co. will continue development work and add to the present ore-reserves during the winter months.——The Welch-Worland Mines Syndicate will operate both mine and mill this winter, employing 12 to 20 men underground and three shifts of 10 men each at the mill. The forces will be increased next spring.

Rico.—Supplies have been laid in at the Smuggler-Almont property at Dunton by the Mount Pleasant Mining Co.; six men will be employed on development during the winter months.——The Dolores Silver Mines, Inc., is shipping steadily and will continue winter operations.——The Rico Wellington reports that the drift from the Mountain Spring tunnel shows iron pyrite which has heretofore been associated with the ore deposit.

IDAHO

Coeur d'Alene.—The Hecla Mining Co. has declared a dividend of $170,000, at the rate of 17c. per share. The forthcoming disbursement will increase the dividends for the year to $670,000 and the grand total of dividend payments to $9,005,000. Operations are proceeding steadily at the properties of the company.

The Silver Reef Mining Co. is reported to be working two shifts, making nine feet daily in the cross-cut. It is expected that it will be necessary to go 900 ft. to reach the orebodies found in the Silver Reef tunnel, the objectives of the present work.——The North Bunker Hill Mining Co. is drifting west on the big vein and is near an ore-shoot, according to reports. Two shifts are at work.

Hearings were begun before Judge Deitrich on November 30 to determine the amount the Federal Mining & Smelting Co. shall pay the Star Mining Co. as compensation for ore removed from Star ground. Claiming that the judgment is in error, and rendering the accounting under protest, the Federal company calculated the net proceeds to be $71,786.14. The Star company, on the other hand, contends that the amount due it, including interest, is $2,477,061.13 if the trespass be held inadvertent, and $3,721,796.97 if the trespass is decided by the court to have been willful.

MICHIGAN

Houghton.—The recent statement that Seneca is expecting to produce copper at about 7c. per pound has aroused considerable comment. If it does that, it will be the lowest cost producer on record. In this connection, the costs of other companies are of interest. Seneca's neighbors, Ahmeek and Mohawk, also on the Kearsarge lode, produced copper at 11.5 and 13.1, respectively, in 1920; in 1917, Ahmeek's costs were 9.4 and Mohawk's 11.3. The costs of other companies in this district are as follows:

	1920	1917
Calumet & Hecla	15.3	13.1
Copper Range	13.9	12.5
Isle Royale	16.8	15.7
Osceola	19.5	13.8
Wolverine	18.0	11.7
Quincy	17.7	17.8

It also has been stated that Seneca is pointing toward a daily production of 7000 tons of rock from both the Seneca and Gratiot shafts. From four operating shafts Mohawk is producing 2600 tons daily, while the Wolverine's two shafts are yielding 1000 tons. Seneca would require additional milling facilities before it could handle such a large tonnage as contemplated. Rock taken out during the course of development is being treated at the Baltic mill, but when regular production is started, Seneca will utilize the two heads it has acquired from the Hancock Consolidated in the Lake milling plant at Point Mills.

Quincy is still striving to make 'a new dollar for an old one' on a curtailed basis of operation, providing work for as many men as possible to tide them over the winter. Only one stamp-mill is in operation and the 'rock' being sent to the mill keeps between four and five heads busy.

Early this month Mayflower will discontinue work temporarily on the 1700-ft. level and will move its four drills to the 1400-ft. level for an exploration of the ground where the vein was first opened by the shaft.

Preparations for a resumption of sinking at Gratiot No. 2 shaft, Seneca, are proceeding. Cement is now being poured for the shaft collar and a concrete foundation is being built for the new hoist. A survey is under way for the extension of the Mineral Range railroad-tracks to the Gratiot and Seneca shafts. It is this railroad which will serve Seneca when regular production is started. All drifts in Seneca are reported to be continuing in satisfactory ground.

The last copper out of the Lake district by boat this season was shipped on November 28 when a steamer left with an estimated cargo of 9,000,000 lb. This was one of the largest cargoes for several years. It is believed most of the copper is intended for export. The boat visited all of the smelters in the district. November shipments will compare very favorably with those of October. Copper has been moving in greater volume than generally believed and there is a distinct feeling of optimism.

MONTANA

Butte.—Contrary to published reports, the East Butte company will not shut-down its mine and smelter as a result of the suspension of production by the Davis-Daly company. The latter has been selling its copper ore to the East Butte company for treatment, but 60% of the ore smelted has come from East Butte's Pittsmont mine. The company is earning a profit on its operations and has not shown red-ink figures in a single month this year. It laid its copper down in New York when the price of the metal was around the 12c. level and made a profit of more than a cent per pound, so that it can be appreciated what the company is showing in the way of profits with the metal at current prices. And the management is selling only enough copper to keep itself in a liquid condition. Work in the new No. 4 shaft is progressing satisfactorily. This shaft has been raised from the 1800-ft. level and on November 20 was within 125 ft. of the surface. Barring any unusual obstacles it should hole through within a few weeks, when steps will be taken to equip it for actual mining.

Helena.—M. H. Welton is preparing to build a new plant for saving flour-gold in Golconda gulch, Jefferson county. He has just returned from New York, where he went to buy the machinery. The ore to be worked will be mined from the Bunker Hill and Bunker Hill No. 2.

The Revenue mine and mill and also the Missouri mine and mill are operating. The first is near Norris and the latter on Meadow creek in Madison county. The metal is gold. A concentrating mill is about ready to start at the head of Alder gulch.

A car of ore is consigned to the East Helena smelter from the Gray Eagle mine, Grass Valley district.

Cross-cutting is going ahead from the Howard shaft of the Drumheller-Woldson group of claims in the Scratch Gravel hills. The width of the vein has not as yet been dedermined, but the shaft and drifts have exposed an extensive body of ore.——Gold ore of shipping grade is coming from the Fairview mine.

New work is going on in Grizzly Park, south of Helena. A boiler and pump has been installed at the Old Kennedy gold property, which is to be unwatered. Western capital is behind the enterprise.

NEVADA

Cherry Creek.—E. T. Godbe and George Z. Smith are produring 8 tons of ore per day from their lease on the Exchequer property, where operations are now under way on the 250-ft. level of the Imperial shaft. Shipments of silver-gold ore assaying $45 per ton are being sent to the American Smelting & Refining Co., at Garfield, Utah. There are said to be many thousands of tons of $15 ore in sight that might be profitably handled in a concentrator.

Ely.—Blister copper is being shipped from the Nevada Consolidated company's smelter in train lots. It is reported that only 50 carloads of the 10,000 tons to be shipped remains. This should be disposed of within a few weeks.

Lovelock.—The Seven Troughs Reorganized Mines Co. has been formed as a consolidation of the Seven Troughs Coalition Mines Co., the Seven Troughs Mining Co., owner of the Fairview mine, and other small companies. The new company will undertake the driving of a tunnel which will tap the Coalition ground at a depth of 1100 ft. and will eventually go under Signal Peak at a vertical depth of 1420 ft. The tunnel will be 5700 ft. long, from its portal to the sideline of the Coalition. This plan of developing the Seven Troughs properties has been under consideration for many years but because of so many conflicting interests and the cost necessary to perform the work it was never possible for one company to carry on the enterprise, but it is expected that through the consolidation ample finances will be secured. It will cost about $200,000 to complete the work, according to John G. Huntington, of Reno, engineer for the company.

During the active development of the Seven Troughs district from 1907 to 1917 little attempt was made to take out the lower-grade ore, only the best being selected, and engineers state there is considerable low-grade ore already stored in the stopes. Water prevented deep mining through the Coalition shaft, and the property was closed down about four years ago.

Mina.—The flotation plant of the Simon Silver-Lead Co. is treating 100 tons of ore daily and will soon be handling 150 tons per day, it is expected. The process is said to be completely successful and shipments of silver-lead and zinc concentrates will start soon. The company is planning to develop its Simon Contact property, adjoining the main holdings, through the Simon Silver-Lead shaft.

Reno.—It is reported that ore-buyers representing the Wabuska smelter are visiting the districts in southern Nevada for the purpose of making contracts for the purchase of ore, in anticipation of starting operations at the smelter. A ruling of the Interstate Commerce Commission recently fixed a new low rate on shipments of copper ore from Plumas county, California, to the Wabuska smelter. This will make it possible for the plant to be re-opened and for the smelting company to purchase silicious gold and silver ores for treatment. The rate from Tonopah to Wabuska will be approximately $5 per ton as against $20 for shipment to the smelters in Salt Lake valley.

Spanish Belt.—The 50-ton mill of the Consolidated Spanish Belt Co. has been given a trial run and has proved successful. A recovery of 88% of the silver is made by using flotation, the concentrate averaging 170 oz. silver, $6 gold,

4% lead, and 2% copper. Years ago the mine produced high-grade ore, but the efforts of the present company have been directed toward the development of a large reserve of low-grade ore; 10,000 ft. of underground work has blocked out a large tonnage containing 15 oz. silver per ton. R. Dean Bradley is superintendent of the new plant.

Tonopah.—After refusing to join with other Tonopah mining companies in a reduction in the wage-scale on April 16 and maintaining the old scale since that time, the West End Mining Co. on December 1 posted notices reducing wages 75c. per day, making the scale uniform in all mines. The reduction will become effective on December 16. The West End avoided a strike in the spring by refusing to join the other companies in the lower wage-scale and was one of the few companies to maintain the old scale. While a strike was on at the other mines the West End continued operations and it was partly because of contributions made by its workers to the miner's strike fund that the strike was prolonged. The higher scale has also been maintained by the West End since the Tonopah strike was declared off.

UTAH

Alta.—The width of the orebody recently opened at the Alta Tunnel & Transportation Co.'s mine shows no signs of decreasing. At present the face is 20 ft. wide and 5 ft. thick, and the deposit is said to be dipping to the south. F. V. Bodfish, manager of the mine, is convinced that the most economical method of mining is to extend the drift from the main level until it cuts the deposit. The sixth lot recently settled for by the Murray smelter gave net returns of $43 per ton.

American Fork.—Mining is active, owing to the mild weather. Between 15 and 20 teams are engaged in hauling ore and supplies. The tramway between the Pittsburg mine and the Pacific mill was completed and placed in operation in December. John Cleghorn, manager for the Globe Mining Co., reports an excellent showing of ore in the property by the American Leasing Co. The Leasing company has been driving a drift through the Globe property and has found ore, which now has a width of between 7 and 8 ft. A 50-ton shipment has been made to the International smelter.

Eureka.—A new 300-hp. motor has been received and installed at the Eagle & Blue Bell mine. Operations have been curtailed at times on account of the burning-out of the old motor, and the new one has been purchased to prevent similar delays in the future. William Owens, superintendent, reports conditions at the Eagle & Blue Bell and Victoria mines as excellent.

Ore shipments for the week ended November 26 totaled 170 cars, as against 164 cars for the preceding week. The Tintic Standard shipped 55 cars; Chief Consolidated, 44; Victoria, 16; Dragon, 16; Iron Blossom, 13; Eagle & Blue Bell, 7; Centennial-Eureka, 4; Colorado, 3; Swansea, 3; Grand Central, 3; Empire, 2; Mammoth, 1; Bullion-Beck, 1; Castleton lease, 1; Sunbeam, 1.

Park City.—The Park-Utah Mining Co. is driving a long drift for the purpose of developing what is known as the Frog Valley fissure. This drift will have its terminus in Deer Valley, a short distance from the Judge smelter. Geologists who are familiar with the eastern section of the district believe this exploratory work will result in uncovering orebodies as large and high-grade as any heretofore discovered at Park City. The work now under way by the Park-Utah is the first real attempt that has been made to explore that section.

A shipment of screened material from the Iron Drift at the Silver King Consolidated property netted $50 per ton, or $1000 for the lot. The screenings were collected from pyrite; it is reported that there is a considerable amount of this material available for shipment.

Ore shipments for the week ended November 26 totaled 2110 tons, of which the Judge allied companies shipped 911; Silver King Coalition, 721; Ontario, 428; and the New Quincy, 50. Shipments the previous week totaled 2279 tons.

The directors of the Silver King Coalition Mines Co. declared a dividend of 15c. per share, payable January 2. This is the second dividend declared this year. It will call for the payment of $187,500, and bring the grand total up to approximately $15,600,000. The building for the new 450-ton concentrator is finished, and machinery is being installed. It should be ready for operation early in the new year.

The New Quincy Mining Co. will devote its entire efforts on development of the orebody opened in a winze from the 700-ft. level from the Little Bell shaft. All other development work was stopped on December 1. A second drift has been started to follow the ore out from the winze. The third shipment of 50 tons, made from the recent strike, gave returns of 0.04 oz. gold, 54.7 oz. silver, 13.5% lead, and 1.16% copper, netting the company, after deducting freight, smelting, and sampling charges, $46.67 per ton.

Salt Lake City.—The Mining Committee of the Salt Lake Commercial Club has asked Governor Charles R. Mabey to appoint an honorary State Geologist, and to recommend in his next message to the Legislature the creation of a permanent position of State Geologist. The Committee holds the opinion that Utah has expended practically nothing to promote the mining industry, which is the greatest factor in the industrial life of the State. The attention of the Governor is also called to the fact that practically every other State in the Union has a State Geologist, and that Utah, by reason of its large and varied mineral output, also should have such an official.

BRITISH COLUMBIA

Alice Arm.—Work at the Bellevue mine, in the Illiance River district, has been suspended for the winter. The summer's operations are said to have been satisfactory; a good deal of surface-trenching and stripping has been done, and a belt of ore 25 to 50 ft. in width has been traced for 3000 ft. The ore is said to carry about 4% lead, 5% zinc, 20 oz. silver per ton, and a little gold. A tunnel has been started to develop the orebody at depth.

Hazelton.—J. S. Kelley has sold the Judges group, in the Babines, to an English syndicate for $85,000.——P. J. Higgins and associates, who are driving a tunnel on the Silver King group, at Driftwood creek, to develop a promising lode that has been exposed at the surface, have cut a strong vein 60 ft. from the portal that had not been discovered on the surface. The vein is well mineralized with gray copper and arsenical pyrite.

Nelson.—W. B. Pool, manager of the Reno mine, reports an important discovery at the Nugget mine. A long cross-cut was driven from the Motherlode workings to cut the Nugget vein last year; a 12-ft. body of ore, supposed to be the Nugget vein, was cut, and drifts were opened in each direction on the vein. Recently the cross-cut was continued to develop other veins on the property, and it soon ran into a large orebody, which is believed to be the real Nugget vein; the vein previously cut being only an off-shoot from the main vein.——James Fisher and partners are about to explore the orebodies of the Monarch mine, at Hall, with a diamond-drill, which is now on its way to the property.

Princeton.—J. J. Warren and W. M. Archibald, of the Consolidated M. & S. Co., have been looking over the Voigt mining claims, at Copper Mountain, and it is rumored that the Consolidated is making negotiations for the property. The Consolidated has a smelter, refinery, and rod-mill capable of turning out 50 tons of finished rods daily, but practically no ore to feed it. The Voigt claims adjoin those of the Canada Copper and are said to be equally good.

Vancouver.—The coroner's jury, which has held a number of sittings since the Britannia Beach disaster and which visited the scene, has brought in a sweeping verdict against the Britannia M. & S. Co. and its officials. It says in part: "The disaster was caused by what is known as the railroad fill, or dump, giving way, and we, the jury, declare that it was criminal neglect on the part of the Britannia Mining & Smelting Co. for deliberately allowing the blocking of a natural mountain stream, known as Britannia creek".

MEXICO

Cananea.—During its present shut-down, the Greene-Cananea Copper Co. is conducting a broad program of underground development and surface expansion. It is remodeling and enlarging its mill and smelter, adding over 500 tons per day to the capacity of its reduction works. In line with the deflationary tendency in the United States, Mexican labor, particularly in the mining district of Sonora, has had a sharp reduction in wages. During the height of the war, ordinary peon labor was getting as high as $4 gold per day with a consequent expansion in Greene-Cananea's cost. During the past few months, however, the wage-scale has undergone a revision and the company will be able to show a much lower cost when the word is given to resume mining. Carried on the liability side of the balance sheet is an item which may be ultimately turned into an asset. At the close of last year the company had a reserve for accounts and wages payable and "taxes accrued" of $2,026,526. A large amount of this was money the company had paid as taxes to the Mexican government under protest. This, however, is being discussed now with Mexican officials and there may be a reduction of no small proportions in the accrued tax item.

Chihuahua.—Miss Sofia Pengoechea has applied for titles to the Ampliacion de Carmen group of gold-silver mines in the mining district of Coyame, adjoining the Carmen, Sofia, and Walkira mines.——Felipe C. Schaefer has located five claims at Guadalupe y Calvo, which are to be titled the Hidden Treasure group.——Ernest Underwood has located the Coronado mines in the Parral district. Some good gold, silver, and lead ores have been extracted during preliminary development.——Alfredo Quijano, of Chihuahua City, has taken up 25 pertenencias in the San Carlos mountains near Ojinaga.——Vicente Real is opening up the Centenario group of gold mines in El Cordon mountains at Batopilas.——The Tres Piedras group of silver-lead mines situated in the Milpillas mountains of the Cusihuiriachic district has been filed on by G. Delgado. The property adjoins the old Tres Amigos and Tres Reyes mines, which have produced considerable ore.

Durango.—Hilario Lozoya, accompanied by a number of prominent American capitalists, arrived here recently to inspect mines and railroads in the Guanacevi district. They will go over the route of the proposed railroad line from Tepehuanes to Guanacevi, in which they are interested.

Herald McLeod Cobb, representing the Mines of Guanacevi Co., has recently taken up the Confin group of gold-silver mines in the Guanaveci district. The property lies adjacent to the Nuevo Porvenir, La Tarcera, and La Sopresa.

On Howe Sound, British Columbia

Torreon.—James I. and J. C. Long and S. E. Gill, officials of mines in Parral and the Parral & Durango railroad, have been touring Mexico in company with a number of prominent mining men and bankers. In the party were A. J. McQuatters, of the Alvarado Mining Co.; Louis E. Stoddard and J. L. Day, of New Haven; William H. Wright, engineer; Franklin Remington, of the Foundation company; J. F. Shaw, banker; Kuno B. Heberline, formerly manager for the Penoles Mining Co.; G. E Stanwood, Boston banker; and J. G. McNary, president of the First National Bank of El Paso. At Chihuahua they visited Governor Ignacio Enriquez, and at Parral an investigation was made of the mining properties of the Alvarado Mining & Milling Co., the Refugio Mining Co., and the Parral & Durango railroad. They are now on their way to Mexico City, where they will call on President Obregon and return to the United States by way of Tampico, where they will make a study of the oil-fields.

ONTARIO

Cobalt.—The La Rose Consolidated has decided to go deeper on the Violet vein where results on the 530-ft. level have been satisfactory. A shoot of ore 225 ft. in length has been developed, both ends of which are still in ore. The winze is being put down to 600 feet.

Goudreau Township.—Following the satisfactory showing made in the sinking of the shaft on the Porter mine $200,-

000 will be spent in developing the property. Other holdings in the area are showing up well. Sixteen claims held by Thomas Powell and others, some distance east of the Porter, have been optioned by a Detroit syndicate.

Kirkland Lake.—The plan for the reorganization of the Teck-Hughes will be submitted to a special meeting of shareholders called for December 7. It is proposed to increase the capital from $2,500,000 to $4,000,000 and to provide for the sale of unissued stock at 15c. per share. The stock is to be offered to shareholders on the basis of four shares of the new for five of the old, leaving the unsubscribed balance available to the bondholders. The outstanding bonds of the company amount to $500,000, with arrears of interest to the amount of $135,000. An issue of five-year 7% first-mortgage bonds is proposed, to retire the bonds now due.

Porcupine.—The McIntyre has declared its regular 5% dividend, payable on January 2. R. J. Ennis, general manager, states that the geological structure at the present depth of 1875 ft. is such as to indicate a long life for the mine. The management has decided to sink the shaft 100 ft. lower. When this has been accomplished and the lower levels opened, the company, provided an enlarged supply of electric power is secured, will proceed with the construction of a mill on the north side of Pearl lake. This will be in addition to the 250-ton enlargement previously announced.

The Nipissing has drilled a fifth hole on the Rochester property and will continue the work of exploration. The management is reticent as to results, but it is stated that veins with encouraging gold content have been found.

South Lorrain.—It is officially stated that the Mining Corporation of Canada has taken a working option on the Haileybury-Frontier property. The mine has been developed at the 150-ft. and 300-ft. levels, on both of which a good deal of commercial ore, including some high-grade, has been opened. The Mining Corporation is employing extra men and will make considerable additions to the mining plant.

STRAITS SETTLEMENTS

Penang.—One dredge has been put into operation on its Malay tin property by the Yukon Gold Co. Two others will be set in place during the next few months. The Yukon company plans to become the largest tin producer on the entire Malay peninsula. Because of the excessive export duty levied by the local government, however, the company will market its output on the ground to Straits smelters. With tin at 28c. per pound this market has dropped below the average cost of production and has forced the cessation of mining and shipping from Bolivia, from which country comes the bulk of tin ores and concentrates sent to America. Thirty-cent tin would enable most producers to break even, but even this price would be 10c. below the average of the past 15 years. The new plant of the Yukon company in Malay will involve the expenditure of $5,000,000, and this amount will eventually be financed through a new security issue. Leading interests in the company will continue to advance required funds until such time as permanent financing can be accomplished.

YUKON TERRITORY

Dawson.—Notice has been received here that the Federal government has suspended the embargo against the exportation of ores from Yukon Territory for 12 months, in order to facilitate the movement of ore from Mayo Landing when navigation opens in the spring. The embargo originally was imposed as a war-measure, and there seems to be no good reason why it should not have been removed entirely.——A new gold find is reported on a tributary of the Stuyahok river, 35 miles north-west of Marshall, in the Fortuna Ledge district. The deposit is said to be 25 ft. deep, and is running from 85c. to $4.50 per pan. A number of claims have been staked, and arrangements have been made for extensive open-cutting operations next spring.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Joseph Errington is at Vancouver.

H. H. Webb is at the Fairmont hotel.

F. W. Bradley has returned from Alaska.

Walter Hovey Hill is at Pittsburgh, Pennsylvania.

Frank M. Smith, of Spokane, is on his way to New York.

George W. Baekeland, recently of Golden, Colorado, is in Paris.

George E. Stephenson has returned from New Zealand to London.

Andrew Nisbet has moved from San Leandro to Natoma, California.

R. D. Winne is at Dundu Angola, in the Belgian Congo, West Africa.

Joseph Clark has moved from Louisville, Ohio, to St. Louis, Missouri.

J. H. Rodgers has moved from Felix, California, to St. Louis, Missouri.

Louis J. Joubert has moved from Comptonville to Oakland, California.

Walter F. Brown has left Chichagoff, Alaska, and is now at Clarkston, Washington.

Erle Huntley has been appointed manager of the Laloki copper mines in New Guinea.

James Martin, recently of Yucca, Arizona, is now at the Cedar mine, Kingman, Arizona.

E. E. Slack, of Warren, Arizona, will be at Cananea, in Sonora, for about three months.

D. C. Jackling is in New York. He expects to return to San Francisco before Christmas.

Stanly A. Easton, general manager for the Bunker Hill & Sullivan company, is at Washington.

M. J. Dailey, mine manager for the Silver King Coalition Mines Co., is visiting at O'Neill, Nebraska.

Arthur W. Allen, Associate Editor of the 'M. & S. P.', has been visiting Ajo and Bisbee, in Arizona.

John Dern is seriously ill at his home in Salt Lake City. He returned from Europe about a month ago.

D. J. Argall, mine superintendent of the Perseverance mine, at Thane, Alaska, is at San Diego, California.

E. H. Wells is president of the New Mexico State School of Mines, Socorro, New Mexico, in place of **A. X. Illiniski.**

T. H. Jenks has returned to Los Angeles from Sinaloa, Mexico, and is recovering from a severe attack of malarial fever.

Walter W. Wishon is now residing at Kingman, Arizona, where he is engineer to the Katherine Big Four Mines Corporation.

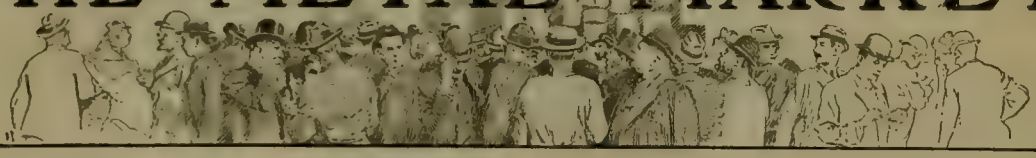
John Smeddle, who has been at the Red Lion mine, at Oatman, Arizona, is now with the Union Corporation of South Africa at Guadalupe, in Zacatecas.

Walter Douglas, president, **P. G. Beckett**, general manager, and **H. H. Stout**, metallurgist for the Phelps Dodge Corporation, were members of a party that inspected the mines and works at Clifton recently.

Henry A. Tobelmann, metallurgist for, and associated with, the New Cornelia Copper Co. and the Calumet & Arizona Mining Co. for the past 16 years, has resigned. He will leave Ajo for New York early in January.

Thomas H. Teal, manager for the Liberty Mining & Reduction Co., at Montezuma, Colorado, is at Sawtelle, California, owing to the closing of the mine for the winter.

THE METAL MARKET



METAL PRICES

San Francisco, December 6

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6
Copper, electrolytic, cents per pound	13.75
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$90
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.00—9.50

EASTERN METAL MARKET

(By wire from New York)

December 5.—Copper is active and higher. Lead is moderately active and firmer. Zinc is stronger and there is more business.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 29	67.25	37.62	Oct. 24	70.64	40.52
" 30	67.50	37.50	" 31	70.04	40.25
Dec. 1	67.62	37.62	Nov. 7	69.46	39.93
" 2	68.00	37.50	" 14	67.28	38.85
" 3	67.00	37.25	" 21	68.54	38.83
" 4 Sunday			" 28	67.55	37.85
" 5	66.25	36.62	Dec. 5	67.27	37.35

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59 90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Nov. 29	13.37	Oct. 24	12.69
" 30	13.37	" 31	12.68
Dec. 1	13.37	Nov. 7	12.75
" 2	13.37	" 14	12.88
" 3	13.37	" 21	13.19
" 4 Sunday		" 28	13.35
" 5	13.50	Dec. 5	13.39

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 29	4.70	Oct. 24	4.70
" 30	4.70	" 31	4.70
Dec. 1	4.70	Nov. 7	4.70
" 2	4.70	" 14	4.70
" 3	4.70	" 21	4.70
" 4 Sunday		" 28	4.70
" 5	4.70	Dec. 1	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Nov. 29	5.15	Oct. 24	5.14
" 30	5.17	" 31	5.07
Dec. 1	5.25	Nov. 7	5.18
" 2	5.22	" 14	5.23
" 3	5.25	" 21	5.18
" 4 Sunday		" 28	5.14
" 5	5.35	Dec. 5	5.23

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Nov. 8	40.00	Nov. 22	40.00
" 15	40.00	" 29	40.00
		Dec. 6	46.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	66.00	....
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

ADVANTAGES OF THE ELECTRIFICATION OF RAILROADS

Some of the striking advantages of electric operation of the railroads are stated by the U. S. Geological Survey. These advantages include the conservation of national resources, both coal and labor; an increase in the capacity of main and yard tracks; an improvement of the physical condition of terminals and an increase in the value of the property, as shown by the New York Central and Pennsylvania terminals in New York City; benefits both to the traveling public and to residents along the route through the elimination of noise and smoke; the possibility of providing multiple level terminals and freight warehouses; and economy in operation through the use of fuel and machinery for generating energy by a few skilful operators in economical stations as contrasted with a large number of technically ignorant operators with small uneconomical machines.

The electric locomotive is equipped with meters that afford complete knowledge and control of operating conditions and that are also a valuable guide in handling the train, particularly in starting a long heavy train. With electric traction the economy of the entire sequence of operation is not dependent upon one man, as it is with steam. Operation is therefore no longer a matter of individual judgment, skill, or fidelity. It is this unfortunate human element that nullifies the theoretical advantages of the "full-jeweled movement" steam locomotive. The effectiveness of the devices for increasing efficiency and capacity necessarily depends on the intelligence and faithfulness of the average engineer.

The inherent wastefulness of the steam locomotive is proved by its own advocates in their claim that "40% of its coal can be saved by the careful use of auxiliary devices". Then why be skeptical, it is asked, of a saving of 60% by a modern power-station, which has all these devices in greater completeness and, in addition, has brains to use them?

The speed of different classes of trains run by electricity will be more nearly uniform. Much heavier trains can be handled, and at the same time light freight-trains can be moved at the speed of local passenger trains. It has been proved that for the heaviest freight service, such as mountain-grade work, the electric locomotive is superior to the steam locomotive, but its superiority in handling light freight at high speed is not so generally understood.

The electric locomotive can be kept at work on the road for 20 hours per day, and if operated at an average speed of 25 miles per hour it can run 500 miles per day. This mileage, however, is double that of the electric passenger engines now used on the New York, New Haven & Hartford line and is higher than would be obtained as an average, but there is every reason to believe that an average between 250 and 500 miles can be made.

MONEY AND EXCHANGE

Foreign quotations on December 6 are as follows:

Sterling, dollars:	Cable	4.08¾
	Demand	4.09¼
Franc, cents:	Cable	7.63
	Demand	7.65
Lira, cents:	Demand	4.41
Mark, cent:		0.57

Eastern Metal Market

New York, November 30.

The month closes with a record of having been one of the most active in some time, though in general the markets are all a little quieter than a week ago. Prices are well sustained for the four leading metals. The Thanksgiving holiday on November 24 has had the usual retarding effect.

Copper prices have advanced moderately and buying and inquiry are good.

The Straits tin market has turned very quiet.

Lead continues in steady quiet demand at firm prices.

Demand for zinc is very light, but prices are fairly firm.

IRON AND STEEL

There is no development in prices. On smaller lots of plates, shapes, and bars 1.60c. is commonly the basis, and as heretofore, larger business is done at 1.50c. The American Sheet & Tin Plate Co. opened its books on November 23 for 1922 business at 3c. for black, 4c. for galvanized, and 2.25c. for blue annealed sheets. Independent companies are naming these prices also, but the present inactive market has not seriously tested them. Winter operation of tin-plate mills promises to be on a good scale, in view of the thorough depletion of stocks. Welsh makers of tin plate, with 40 shillings ocean-freight to Vancouver, took 150,000 boxes there lately at close to $4.25 per box, duty paid. This is well below any American competition.

COPPER

Some sellers report a quieter market while others state that inquiry and sales keep up at a satisfactory pace. At any rate the situation is considered excellent and the tone firm. A good business has been done, particularly for future and first-quarter delivery and prices have advanced moderately. Electrolytic copper for this year's delivery is now quoted generally at 13.62½c., delivered, or 13.37½c., New York or refinery, while for January and first quarter the minimum is 13.75c. delivered, with some sellers quoting ⅛ to ¼c. higher. Sales for foreign consumption are exceedingly good with Germany and England the largest buyers. Exports to Germany for the first nine months and the year have been more than those to England and France combined.

TIN

The market has turned very quiet in decided contrast to the marked activity which prevailed a week ago. The Thanksgiving holiday is one cause, doubtless, but the temporary satisfying of the large needs is another. Of still more influence is the higher London market where prices have advanced sharply this week. The firmer and higher value of exchange is a factor. Actual buying of Straits tin has been negligible and there is very little to report. Prices are firm to higher as influenced by the factors enumerated, with spot Straits tin quoted yesterday at 29.87½c., New York. Quotations yesterday in London were about £2 per ton higher than a week ago at £163 5s. for spot standard, £165 for future standard, and £163 10s. for spot Straits. Arrivals thus far this month have been 2525 tons of which only 50 tons have come in at Pacific ports. The quantity reported afloat is 4150 tons. Quotations for American electrolytic tin are nominal.

LEAD

The chief matter of interest in the lead market is the growing strength of the British market where lead appears to be scarce and where prices are advancing. In the last week the London market has gone from £24 15s. to £26 per ton, for prompt delivery, due to the fact that there is less metal available from Mexico and Spain, in particular. The market here continues in its rut of steady demand at firm unchanged prices. The leading interest continues to quote 4.70c., New York and St. Louis, while in the outside market quotations are 4.35c., St. Louis, and 4.70c., New York.

ZINC

Buying is light and spasmodic and apparently confined to the immediate needs of consumers, particularly galvanizers. With a view to keeping down stocks for inventory purposes, purchases are generally of a hand-to-mouth character. Added to this is the lack of selling-initiative by most large producers. The market is therefore a waiting one, but the tone is cheerful and the outlook bright. Due to offerings from at least one source late last week at close to 4.60c., St. Louis, the market shaded slightly, but it is now firm. Prime Western in wholesale lots for early delivery is quoted at 4.65c., St. Louis, or 5.15c., New York.

ANTIMONY

Wholesale lots for early delivery are quoted unchanged in a quiet market at 4.50c., New York, duty paid. Jobbing lots are about ¼c. per pound higher.

ALUMINUM

The suspicion entertained for some time that the leading domestic producer was selling under its quoted price of 24.50c., f.o.b. plant, for wholesale lots of virgin metal, is now confirmed as a fact by the announcement that since about November 15 its price has been 19c. This puts it nearly on a par with the quotations of importers of the same grade of 17 to 18c., New York, duty paid.

ORES

Tungsten: The market is devoid of interest, partly due to the reluctance of holders of ore to dispose of their supply at prevailing prices. One report is to the effect, however, that some have sold their stocks to obtain cash before the year-end. Prices are a little lower as a result with the minimum at $2 per unit for Chinese ore; other grades are higher.

Molybdenum: A few sales are reported at 45 to 48c. per pound of MoS_2 in 85% concentrates.

Manganese: Stocks are heavy in consumers hands and there is absolutely no demand. Prices are nominal at 20c. per unit, Atlantic seaboard, for high-grade foreign ore. Imports were heavy in October at 36,760 gross tons as compared with only 14,823 tons per month for the third quarter.

Chrome: Chrome-ore stocks are also reported as heavy and there is no new demand nor is any expected before 1922. Rhodesian and Indian ores are quoted at $21 to $22 per ton c.i.f. Atlantic ports.

FERRO-ALLOYS

Ferro-manganese: There is almost no activity, the only business heard of being 100 tons sold by the Steel Corporation on a basis of $60, Pittsburgh. There is a rumor afloat that British prices are to be raised, but it is unconfirmed. Quotations for British and domestic alloy are unchanged on a basis of $58.35, Atlantic ports. Imports in October were heavier than in some months at 1943 tons, which compares with 499 tons per month for the third quarter.

Spiegeleisen: The market is flat with quotations unchanged at $25 to $26, furnace, for the 20% grade.

Ferro-tungsten: There is no demand and prices are nominal at 40 to 45c. per pound of contained tungsten in the domestic alloy and at 50c., duty paid, seaboard, for the foreign.

Ferro-silicon: The market for 50% ferro-silicon is firm at $60, delivered, per ton, with no activity reported.

Ferro-chromium: Quotations for standard alloy vary from 10 to 14c. per pound of contained chromium, with no demand recorded.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A BELT-CONVEYOR MADE OF STEEL

In a recent issue of a well-known engineering publication the following statement was made: "By means of belt-conveyors large carrying capacity is combined with low power-consumption. Belts usually take 50% of the power used by other conveyors, so the problem of the engineer is really to see whether or not belt-conveyors can be employed". It is evident from this that belt-conveyors are recognized for their efficiency; a study of industrial conditions reveals the fact that they have been extensively used.

When a belt-conveyor is mentioned it is natural for the engineer to picture in his mind a canvas, balata, or rubber belt. To speak of a steel belt-conveyor immediately brings one into a foreign field and questions arise because of the fact that they have not been used in this country. The Sandvik Steel Works in Sweden has had a wide experience covering about 30 years in the cold-rolling of steel. About 12 years ago it began to make steel belt to be used for conveying purposes. In various phases of industry it has met with decided success.

The flexible-steel belt, known as the 'Sandvik' belt, is made from the very best Swedish charcoal-steel with a percentage of carbon of about 0.65; it is cold-rolled, hardened and tempered by a special process, which was originated by the Sandvik works and perfected after many years of experiment. The Sandvik works has always made a specialty of high-grade cold-rolled material, and for this purpose it has acquired controlling interest in a large number of the world-famous Swedish mines producing iron ore low in sulphur and phosphorus.

To date, about 1300 steel belts have been made for handling coal, coke, charcoal, iron ore, concentrate, copper ore, phosphate ore, sulphur ore, rock, and numerous other materials. The steel belt-conveyor is especially suitable for conveying warm, sticky, sharp, or abrasive material which rubber and fabric belts cannot handle satisfactorily. The advantages of the steel belt over apron-conveyors and wire-woven belts are the elimination of heavy maintenance costs, power consumption, and the spilling through joints and interstices.

A Sandvik Steel Belt, 285 ft. Long, 16 in. Wide, and 0.035 in. Thick. Weight, 550 lb.

Left—Adjustable Scrapers Showing How Sandvik Belt Can Be Discharged at Different Points. Right—Interior View of an Iron-Ore Concentrator

The 'Sandvik' belt has an especially hard, smooth, and dense surface which accounts for its great durability and high wear-resisting qualities. The belt, when installed as a conveyor with standard-size pulleys, is subjected to a working stress of 28,000 to 30,000 lb. per square inch when traveling over the pulleys. The manufacturing process also imparts properties that make it particularly adapted for conveying hot material. By the special method of heat-treatment, hardening, and tempering the Sandvik belt acquires better rust-resisting qualities than common cold-rolled steel of similar composition.

As compared with flat rubber belts of the same width, the steel belt possesses greater transverse rigidity and therefore a higher capacity, as the edges, even with a one-sided load, do not yield in a downward direction. This allows a relatively broader part of the belt to be used for carrying the load. These attributes are obvious and are due to the fact that the steel belt is less flexible than the textile fabric.

As a result of the unavoidable vibration in a textile belt while running, the material conveyed has always a certain tendency to spread, and therefore the width of the loading-area in most cases can not exceed one-third of the width of the belt, whereas, in the case of a steel belt, two-thirds of the width may be used without danger of spillage, on account of the fact that it runs smoothly. This fact is also partly accounted for by the greater rigidity of the steel belt, which allows greater distances between the supporting rollers, thus less disturbance of the material.

A special feature is the remarkable ease and simplicity with which material can be discharged at any desired point along the conveyor without the use of cumbersome and expensive trippers. The belt does not stretch and the tension devices are therefore very simple, as they only have to take up trifing variations in length, caused by changes of temperature. The 'Sandvik' conveyor is designed in two ways, either with the conveying strand sliding on a wooden support, sometimes fitted with skirting boards, trough-like, the return strand being supported on idlers, or else both strands of the band are carried on rollers in the usual fashion. For carrying heavy, hard, and abrasive materials the roller supported type is preferable, the material being placed centrally on the belt and the edges left free, as is the general practice with flat-band conveyors. Steel belts can not be troughed like textile bands, which reduces their capacity for the same width, but this fact is compensated for since, as previously mentioned, a flat steel belt has a wider loading-area.

It is obvious that the introduction of the steel belt has widened the field of application of the belt-conveyor, which previously had not been suited for conveying hot and sticky materials when only the textile and rubber belts were available. Sharp-edged cutting materials, such as glass, can also be transported on this belt. Finally, material which, on account of its high temperature, can not be handled on belts of rubber or balata, can be handled by the steel belt. All these are advantages which open up a wider field of usefulness for the belt-conveyor, and should be welcomed by the engineer interested in the handling of materials.

THE SULLIVAN DISPLACEMENT-PUMP FOR ELEVATING ACID BY COMPRESSED AIR

For several years past the use of compressed air for pumping acid has been widely extended, as the more modern principles of the air-lift method have been applied securing greatly increased efficiency and convenience.

Ordinary simple or even compound air-lifts have their limitations in this field, however, due to the low factor of submergence frequently encountered. The saturation of the air by the acid has also resulted in undesirable fumes and in losses due to precipitation at the point of discharge.

The Sullivan pneumatic-displacement pump has been designed to avoid these difficulties, while embodying many of the advantages typical of the air-lift system, and others peculiar to itself.

The pump consists of two cylinders or tanks, side by side, with a common inlet and a common discharge opening, each provided with check-valves. The tanks fill by gravity, and are alternately emptied of their contents by direct air-pressure, which carries the liquid being pumped to the desired elevation. The filling and emptying of the tanks is controlled by the Sullivan automatic switch, which is placed above the level of the acid and operated by air from a line independent of that which supplies the tanks. The operation of the switch, by alternately admitting compressed air to each tank, secures a continuous discharge of acid into the storage tank or basin.

By means of a single adjustment, made by turning a control-valve, the suction-lift and capacity of the pump are varied to suit changing requirements. The action of the switch is fully automatic, and it will run continuously as long as the air-supply is maintained. Among the advantages of the new displacement pump are the following:

1. The liquid to be pumped does not come in contact with any moving parts, such as floats, except the inlet and discharge check-valves.

2. Clearance losses are avoided, since the automatic switch leads the expanded air from the empty tank into the full cylinder before admitting live air to the latter, thus filling the lines and clearance spaces.

3. Power and time losses in overcoming inertia are obviated by this method of re-using the exhaust air, thus starting the acid before live air is admitted.

4. The speed of switching is governed effectively by an accessible valve, without other adjustment or change of parts.

5. The air-pressure to the switching apparatus is regulated by an independent diaphragm reducing-valve, securing positive and equal timing of the switch-movement, regardless of the pressure in the air-receiver.

6. There is no precipitation loss or emulsification of the acid being pumped. The compressed air does not mingle with the liquid, but merely exerts direct pressure upon its surface.

7. The pump and exposed parts may be made up of steel, cast-iron, bronze, or other materials designed to resist the chemical action of the acid to be handled.

8. Pumps may be supplied for any desired capacity and lift, and for liquids of any specific gravity, within a wide range.

CREDIT TO THE U. S. BUREAU OF MINES

In this department of the 'Press' for November 12, mention was made of an interesting moving-picture exhibit called 'The Story of Rock Drilling'. The fact should have been stated that this film was prepared by the U. S. Bureau of Mines in co-operation with the Sullivan Machinery Co. The equipment shown is all of Sullivan manufacture and the production was financed by the Sullivan company, but credit for the idea and for the distribution of the film is due to the engineers of the U. S. Bureau of Mines.

COMMERCIAL PARAGRAPHS

The Associated Machinery Corporation is a new organization, consisting of the Pawling & Harnischfeger Co. of Milwaukee, the Insley Manufacturing Co. of Indianapolis, the Chain Belt Co. of Milwaukee, and the Novo Engine Co. of Lansing. Its purpose is to co-operate in the development of trade in India, Ceylon, and Burma.

The Koppel Industrial Car & Equipment Co., large manufacturer of industrial cars, narrow-gauge track materials, etc., has opened a new district office at Kansas City, Missouri, in the Railway Exchange Bdg. Harry C. Kraft, formerly with the New York office, has been appointed manager for the Kansas City district.

Dwight P. Robinson & Co., engineers and constructors of New York, have recently secured contracts from the Middletown Hotel Co. for the construction of a five-story hotel at Middletown, Ohio, and from the Sterling Salt Co. of New York for the design and construction of a salt warehouse with conveying equipment at Cuylerville, New York.

The Mutual Truck Co.'s plant and equipment at Sullivan, Indiana, will be offered at public sale by the receiver, on December 22. The sale will include 12 acres of land with siding to the C. & E. I. and Illinois Central railroads; a large modern brick building with steel-truss roof; heating-plant, machine-tools, drawings, blue-prints, and a miscellaneous stock of materials and parts for building a 2½-ton motor-truck. The First National Bank, Sullivan, Indiana, is the receiver, and E. D. Maple is the trust officer in charge.

Mining and Scientific Press

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T. A. RICKARD, - - - - Editor

THE annual meeting of the Northwest Mining Association will be held at Spokane on February 14 and the four days following.

SETTLEMENT of the civil war in Ireland and the unmistakable success of the Washington Conference must be causes of annoyance to Hearst, Brisbane, and their crew of mischief-makers, for these events have decreased the chances for international conflict. If now Hearst and his yellow papers could be given appropriate sepulture in deep water off the island of Yap, we would call it a real Merry Christmas.

LABOR disputes have laid a heavy hand on the industrial progress of Australia. Since the Broken Hill Proprietary Company started to operate its steel works in April 1915, nine serious strikes have affected operations; these covered a period of 96 weeks, or about 30% of the time. The trouble arose almost entirely as the result of factors over which the company had no control. When the strike was ended at the company's Broken Hill mine in November 1920, work was resumed at once and was continued for about two months, when labor was found to be so costly, in consequence of increased wages and shortened working hours, that operations were again suspended and the mine has since remained idle. Whatever the arguments for or against industrial disputes, there is no gainsaying the fact that they cause a disorganization and an economic waste that is deplorable, from the national and from the individual viewpoint.

PROFITEERING, or charging all one can get, is not a new art of the twentieth century; witness the testimony of Mr. John S. Collins, as related in the 'Saturday Evening Post'—of Burlington in Iowa, by the way, not of Philadelphia. Mr. Collins went to Silver Bow, Montana, in the early 'sixties. The settlement, which has since grown into the city of Butte, consisted at that time of two buildings, one of which was owned by a storekeeper named Dorgan. Along Silver Bow creek and in the neighboring gulches about 250 men were digging for gold. Collins started a store in opposition to Dorgan, his stock being one wagon-load of goods that he had hauled 100 miles, over the continental divide, from Virginia City. The 'going' price for a 98-lb. sack of flour was $50, but during January the snow became unusually deep on the divide, and Dorgan conceived the idea of raising the price of flour to $75, in view of the fact that the arrival of freight by team from Virginia City before spring was unlikely. Collins, it seems, with uncanny prescience, declined to join his fellow merchant. The next Sunday, so the story goes, two wagon-loads of miners called at Dorgan's store and without preliminary parley proceeded to load their wagons with flour, beans, rice, and sugar. For the goods appropriated they paid Dorgan, in 'dust', 25% of his price, which still left him an excellent profit; and as they departed they warned him that "another attempt at profiteering would find him dancing on nothing at the end of a rope". Unfortunately life is more complicated in our day and generation.

BRONZE will be used as a protective covering for 85% of the surface of the steel in the proposed Hudson River suspension bridge, the new $100,000,000 structure that is to connect Manhattan Island with the New Jersey shore. As a consequence it is estimated that $400,000 will be saved annually in the expense of maintaining the bridge, this sum representing the cost of renewing the paint, a procedure that will be obviated by the protection of non-corroding bronze. Some interesting data regarding the bridge are given in the November bulletin of the Copper & Brass Research Association. The Brooklyn bridge across the East river, which has long been considered a marvelous product of engineering skill, is dwarfed by comparison with the new structure. The central span, over the water, will be 3240 feet long, and the approaches on each side will have a length of 1650 feet each. The two principal towers will be 840 feet high, or 48 feet taller than the Woolworth building, and each will have a base 200 by 400 feet. Traffic will pass over two decks, each 235 feet wide; the lower will provide for 12 standard-gauge railway tracks in addition to several hundred pipe-lines and conduits for electric wires. The upper deck will be wide enough to allow the simultaneous passage of 18 lines of automobiles, and will carry two street-railway tracks and two 15-ft. walks for pedestrians. The construction of the two huge trusses that form the suspension members of the bridge is remarkable. Each is composed of two cables spaced from 60 to 80 feet apart, vertically, with vertical panels and diagonal braces between to add rigidity. From the two suspension trusses,

vertical eyebar chains are suspended to support the double-decked roadway. Each of the four cables consists of three chains, the links of which are enormous steel eyebars, 60 to 70 feet long and 16 inches wide; the ends of the bars are connected by steel pins passing through the eyes. Each cable or cord of the suspension truss is composed of three chains, so that there are in all 12 chains spanning the river and sustaining the tremendous load that will be passing over the bridge almost continuously. Each of the four cables is to be enclosed in a gallery of bronze for protection against rain and moisture, which otherwise would attack the steel of which the links are composed. This gallery will completely encase the cord, but will be provided with necessary doors to permit inspection. The eyebars will be painted at the start, but, thanks to the protection afforded by the bronze cover, repainting will not be required for many years. The enclosing gallery will be 15 feet in diameter; although, of course, only a small part of this cross-sectional area is occupied by metal. The magnitude of the new bridge is emphasized by comparison with the four wire-ropes that support the Brooklyn bridge; they are 15 inches in diameter. The bronze obviously will add greatly to the sightliness of the structure, but that is not the reason why the cords are to be covered; the reason is that it is more economical to provide permanent protection than it would be to apply annual coats of paint. The same question of ultimate economy affected by the use of an alloy of copper arises in the erection of any permanent structure, even to the garage that one is building in his backyard.

ONE of the fruits of the President's Conference on Unemployment that promises to be of practical benefit, if it become law and be properly administered, is the bill introduced in Congress by Senator William S. Kenyon of Iowa, providing for the long-range planning of public improvements. No immediate results of consequence can be expected, but the soundness of the theory upon which the bill is based is undeniable. There are two kinds of industry: private and public. The first is conducted by individuals or corporations for private profit; the second is financed and executed for the benefit of the public. Mr. Otto T. Mallery, secretary of the Committee on Public Works of the Conference, presents statistics to show that the difference in wages paid in the United States in 1921 and 1920 is five billion dollars, which he assumes to be the "measure of acute unemployment". He estimates that 742 million dollars is the average annual amount expended for wages by governmental agencies in charge of public improvements. If, then, it were possible to increase the volume of public work threefold during periods of industrial depression there would be an excess expenditure of wages in the slack year amounting to 1484 millions over that of the average year. This will represent the potential usefulness of the proposed policy of regulating public work with a view to compensating for unemployment in private industry. Obviously, if the gross amount of work be not increased, the volume of public work must be diminished during the period of general industrial activity. But history has shown that this activity always moves in cycles; to be specific, since 1900 the depressions have occurred at intervals of from 7 to 10 years. It seems practicable to expand and contract alternatively the volume of public improvements to accomplish the desired end. The bill provides, with respect to the national government, that the head of each executive department be authorized "to postpone the date of the commencement or retard the prosecution of such portions of the public works and projects within his jurisdiction as may be necessary, in order to prepare for and to prevent a further rise in the cyclical wave of industrial expansion and resulting business strain and over-extension and, within the appropriations therefor, to enter upon a maximum program of public works and projects as a preparation for and in order to counteract an impending period of industrial depression and unemployment". [What language these good people do use!] In order to inform Federal officials as well as the heads of State, county, and municipal governments, who are urged to co-operate in the work, the Bill provides that the Secretary of Commerce shall collect and compile regularly statistics bearing on business conditions and the industrial outlook. These, together with the Secretary's conclusions and recommendations, are to be published monthly as a supplement of the Current Survey of Business. In short, the plan is to use public industry as a fly-wheel to stabilize the unavoidable fluctuations of private industry.

IRELAND'S achievement of political autonomy is a happy event; it is of significance to this country because it marks the liberation of the United States from Irish politics, and gives assurance that the old quarrel between England and Ireland will cease to be a menace to the goodwill that should subsist between the English-speaking peoples on opposite sides of the Atlantic. In that goodwill lies the hope of peace for the world; for if we, the common inheritors of Magna Charta and Shakespeare, cannot live in amity, then the outlook will be dark indeed for civilization. It is fortunate also that the Spanish-American who was the least amenable to reason will be, as a newspaper reporter would say, 'eliminated' from Irish politics, for his attempt to go back on the agreement made by the Sinn Fein representatives was an act of bad faith for which no excuse can be made. With De Valera will go, it is to be hoped, many of the extremists who derived support from funds distributed by the Third International and the Bolshevists of eastern Europe. To Mr. Lloyd George is due great credit and the gratitude of all who desire peace and justice in this sad world. We hope that he may soon find it convenient to visit the United States, for he has many characteristics and personally engaging qualities that will make him welcome. Should he arrive at the close of the Washington Conference, if not before, he could, we feel sure, say some things that would stimulate the desire to establish good feeling among the nations, particularly between those which have the same language and the same liberal ideals.

Revision of the Mining Law

The numerous letters on this subject that have appeared in our columns during recent months indicate unmistakably that the mining community does not approve the proposed revision of the mining law. The subject has been discussed freely and at length by representatives of the various types of men engaged in mining. Their expressions of opinion indicate the belief that whereas the existing law has many faults, the proposed new one has fully as many, and that to put into effect so many radical changes at this time would only cause confusion. We join with our clientele in asking Congress to reject H. R. 7736, known as the 'United States Mining Act'.

In this issue we publish several communications on the subject. The first is from Mr. H. Foster Bain, Director of the U. S. Bureau of Mines. Mr. Bain explains the circumstances under which the revision was undertaken and the method adopted in selecting the committee that drafted the proposals for revision. He makes it clear that the sole purpose was to perform a public service by ascertaining the acknowledged defects in the existing law and by suggesting such remedial legislation as would correct them. Some of our prospector friends have assumed that the gentlemen who drafted the proposed regulations were persons unversed in mining and unfamiliar with the conditions for which they intended to legislate, more particularly with prospecting. This is a mistake, as we have stated previously. The committee consisted of mining engineers of wide experience, thoroughly familiar with every phase of mining, including the first discovery of ore and the locating of claims. It is true the members of the committee were consulting engineers of distinction and therefore such as are retained by the big companies, hence their point of view was that of the major operator rather than that of the prospector and small syndicate; this may have caused them to insert some of the clauses to which strong objection has been expressed by the minor operators. It is a pity that prospectors of small means were not represented on the committee, for it cannot be denied that such men are entitled to the kindliest consideration of the mining engineer and of the Congressman. Moreover it is curious that after so much ventilation of the subject before the various technical societies and mining organizations it should have been impossible to draft a code that would be accepted and that would be defended by mining engineers. Nothing has been more marked in the public discussion of the question than the failure of members of our profession to come forward in its support. On the other hand, in private conversation with engineers and operators in various parts of the West we have found few inclined to welcome the new code. Most of the engineers withhold approval and most of the operators are frank in disapproval. Last week we published a copy of the adverse resolution passed by the Montana Mining Association, and the week before we published the text of a similar resolution by the Northwest Mining Association, at Spokane. A letter from the president and secretary of the second association appears in our current issue. It refers, among other matters, to the difficulty of staking claims in conformity with cardinal lines and shows how much ground would have to be located in order to cover a vein on its dip under certain conditions. Here we may refer to the supposed chief benefit of the proposed enactment, namely, the abolition of the extra-lateral right. It is the objection to this and to the litigation caused by it that have provoked the cry for a revision of the law. As a matter of fact this defect in the law is now overcome in large measure by locating or purchasing more ground, and the new law furthers the same purpose by enlarging the area of the claims. The trouble is not so much with the law as with the vagaries of Nature; ore deposits have not the regularity of behavior assumed by legislators and the writers of textbooks; the eccentricities of vein-structure are beyond the discipline of Congress. In districts where apex claims have been located already, no revision of the law can prevent the complexities inseparable from changes in the strike and dip of veins or from the variations of shape and pitch in orebodies. We can state further that the average mine operator, much as he may fume at the 'apex law', would rather refer his troubles to the Courts than to go to a bureaucratic official. He has said so to us. This may seem surprising, for many of the decisions of the Courts have been ridiculed and the litigation arising from the 'Law of the Apex' has provoked the anathemas of mining men; yet now that relief is offered they would "rather bear those ills they have than fly to others that they know not of". Some operators, as indicated by the report adopted by the Commercial Club of Salt Lake City, are willing to accept the abolition of the extra-lateral right, but consider it best to make no other change in the law. For ourselves, we believe that any benefit to result from repealing the law of the apex is belated, that the harm has been done, and that operators are now sufficiently on their guard against it, as is shown by the relatively few cases that come to trial, indicating a growing habit of compromise, and that the introduction of new claims without extra-lateral rights alongside those that have the apex privilege will only cause more confusion. The older mining districts are covered so completely with locations under the present law that any change will apply mainly to new districts, in which under existing conditions the operator will take the precaution of protecting himself by securing ground sufficient to cover the dip of his vein or lode. This means that the prospector has a better market for claims off the outcrop. Here we may mention the fact that the extra-lateral right is the only recognition that we have in our law of the severance of mineral rights from surface rights. This recognition is a good feature. What is needed most today is some way to hinder the passing of title to mineral land into the hands of persons who do not develop, but who wait for others to do so on land next to theirs, thereby obtaining an unearned increment in the value of their own idle property. Large tracts of the national domain have been alienated in this

way, by patent, preventing exploration by those who would be willing to incur the risk. Owing to the small tax levied on patented claims in neglected mining districts, it is possible to hold title at small cost. Apparently the remedy lies with local tax authorities. The subject of mineral-land laws is complex and difficult; the committee of engineers who undertook the revision made a sincere effort, for which they deserve the thanks of the mining community. It is a pity that they tried to do so much and that they grafted their new regulations onto the clauses of the old law, producing a verbal hotch-potch that would be a fruitful incubator of misunderstandings if enacted by Congress. The job was overdone; the resulting code is impracticable.

The Burma Enterprise

In our issue of November 29, 1919, we published a fairly complete history of the Burma mining enterprise, known at various periods by the names of the successive companies that have controlled it. At that time we stated that a new company was to be registered in India, for the purpose of obtaining further favor from the Indian government, including an extension of the mining leases, as well as to facilitate the erection and operation of a zinc-reduction plant in association with the celebrated Tata steel works in India. Various other expansions of the enterprise were described, notably a new concentrator and lead-smelting plant at Namtu, which is 15 miles from the mines at Bawdwin, in the Northern Shan States. The new company, still named the Burma Corporation, was registered in India on December 17, 1919. During 1920 the operating profit was £455,516, of which £246,770 survived as current profit. Besides, it was found necessary to raise more working capital by an issue of £1,000,000 in the form of 8% debentures. The temporary collapse of the metal markets in 1920 compelled the company to abandon most of its ambitious program of expansion, and early in 1921 it was decided to stop the construction of the zinc-plant in India, to discontinue the erection of the new lead-smelter, and to suspend the further development of the Namma coalfield. One unit of the concentrator is now in operation except for the flotation section, and the existing smelter at Namtu is being enlarged and improved with a view to an annual production of 45,000 tons of lead and 4,500,000 ounces of silver, requiring a daily output of 700 tons of ore. This relatively modest program is the result of consultation between Mr. R. G. Hall, whose engagement as resident manager expired in September of this year, and Mr. P. E. Marmion, elected a director a year ago and now appointed as manager in succession to Mr. Hall, together with Mr. A. T. W. Paine, another director, and Sir Trevredyn Wynne, the chairman of the board, all of whom spent several months in Burma for the purpose of an exhaustive investigation. This enterprise has been the subject of many similar technical investigations and one may imagine that it must be tired of the repeated experience of being examined, appraised, and re-organized. It is now 17 years old, but has not paid a dividend. Nevertheless it has received technical assistance from a splendid group of engineers, including Messrs. W. J. Loring, H. C. Hoover, R. Gilman Brown, Theodore J. Hoover, A. F. Keene, E. Heberlein, C. H. Macnutt, T. E. Mitchell, Lawrence Addicks, John A. Agnew, L. J. Mayreis, R. G. Hall, and E. P. Mathewson. The last mentioned is now on the ground. We give the names in chronological order as nearly as we can. Two conditions have been unfavorable to financial success. The first is the shortage of labor, which is particularly aggravated during the wet season, from May to November. The solution of the problem will be found in establishing colonies of natives from China and India in the immediate vicinity of the property and by encouraging the cultivation of individual plots of ground. The directors would be well advised to read the remarks of Mr. H. C. Perkins in our issue of May 19, 1917, on the training and use of native labor. Another unfortunate condition has arisen from the vagaries of rupee exchange. The expenses in Burma are paid in rupees; the rate of exchange has risen from 15 rupees to 7 rupees per pound sterling, so that the cost of labor, food, and local supplies has risen correspondingly. An ounce of silver buys no more in labor or in commodities than when the price of silver was half what it is now. As the lead is sold in India on a sterling basis, the company receives fewer rupees for it, notwithstanding a rise in the market price of the metal. These are some of the anomalies of exchange; when the company was registered in London it escaped from some of them. It looks therefore as if the Indian registration was a mistake. Meanwhile the ore-reserve is enormous and the potential wealth of the mine is unimpaired. The total ore available is estimated at 4,402,218 tons, averaging 23.9 ounces of silver, 25.7% lead, 17.9% zinc, and 1.2% copper. This represents a hundred million ounces of silver and a million tons of lead, together with three-quarters of a million tons of zinc. If Broken Hill did not compete it would be possible to sell the lead and zinc in Asia at a profit, but the mines of the Barrier can produce more cheaply. The capital invested is now equivalent to $70,000,000. The Bawdwin is a great mine; it contains one of the biggest rich orebodies in the world, and the company has had, and now has, the benefit of the best technical advice; but the control has been divided and discordant, so that a consistent and sustained policy has been lacking. This defect is due partly to the disturbance of Indian finance and of economic conditions generally in consequence of the War. Although the company has paid no dividend, the £1 shares of the Burma Corporation, registered in London in 1913, have been quoted as high as £14. This means that the shares have served as counters in a big gamble. When the transfer to the Indian register was made the £1 shares were split into ten; these are now quoted at 6 shillings. This represents £3 as against £14 in January 1920. Thus apparently a great deal of money has been made by those who bought the shares when issued at 15 shillings in 1913, if sold anywhere near the top. More money is made on the bourse than at the bal, as a Cornishman might say.

Revision of the Mining Law

The Editor:

Sir—I have read with much interest the large number of letters that have appeared in the 'Press' since this discussion opened and am sure that they will prove helpful to the Committee of Congress which has the matter in charge. They reflect a deep and gratifying interest in the subject, although in part they also reflect misunderstandings, which must be due to failure to have read carefully the whole Bill or to understand what is now the law. A brief review of the conditions under which the draft under discussion was prepared may help to remove misapprehensions.

As is well known, there has been for many years dissatisfaction with the so-called mining law. This was the natural result of the fact that the United States never had a well considered mining code. What it has is a system of laws, interpreted by Department and court decisions, governing the manner of acquiring or occupying public lands containing minerals. These laws are fragmentary. They are a piece-work of individual statutes usually passed as a measure of expediency to meet a specific situation and only brought into any sort of working harmony by interpretations that have frequently been forced and even fanciful. Even such law as exists is scattered and difficult of access. The general land laws are now in process of codification and in time the laws governing mineral lands will be codified; if not as a result of the present effort, then as an incident to general codification by a body of lawyers. If the miners are to make their influence felt as to what is left out and what goes in, it will be necessary for them to decide among themselves what their experience dictates to be sound and wisely applicable to the future.

When in 1917 it became clear that Congress was in no mood to accede to a request that it appoint a committee or commission to study the actual operation of the mining law throughout the West and to recommend for or against changes that were being urged by individual groups, the matter was referred to the U. S. Bureau of Mines by the Chairman of the House Committee on Mines and Mining with a request for a report. The then Director of the Bureau appointed a committee from among its consulting engineers to consider the matter. He carefully chose this committee from among men not on the permanent staff but familiar with the problem and the actual operation of the laws. It was necessary to use men who could get together and consult, and the committee has in this matter given time to public service that is worthy of the best thanks of the industry. Nor has it worked alone. By means of questionnaires, letters, and conferences the concensus of opinion has been obtained wherever possible from wide circles of mining men. The list of local engineering and mining societies consulted is a long one. Possibly a number of those who now see grave objections to some particular feature of the law as proposed have forgotten earlier appeals to them for expression of opinion.

If any progress was to be made it was clearly necessary for someone to draft in definite form and reduce to legal phraseology the various proposals that had back of them important opinion. This the committee has done, but neither its members, the Bureau of Mines, nor anyone else with whom I have come in contact has taken or would take the ground that the result is a proposal for a perfect law or that it may be, on the whole, wise to adopt every proposal made. This is not an attempt to thrust anything down the throat of anybody. It is an attempt to reduce to form for serious discussion various proposals that have been made. If they are good, they should be adopted; if they are bad, they should not. Whether they are good or bad should be determined by their estimated effect on the whole country and industry; not whether they be for the specific benefit of the large companies, the mining engineers, the lawyers, or even the prospector. The practical problem is what changes, if any, are necessary in order to smooth the way to discovery and development of such mineral resources as are not yet under exploitation.

In preparing its report the Committee first had a lawyer familiar with Land Office practice as relates to mineral lands bring together the scattered fragments of the law as it now is. The necessity for this is illustrated by the fact that one of your correspondents has soundly berated the Committee for proposing what is existing law as regards claim-staking in Alaska. Some of us might have welcomed a suggestion on the part of the Committee that the particular section indicated be omitted, but it is hardly in order to blame a new committee for what is now law. In fact, of the 25 sections in the proposed draft 18 are existing law save for some entirely minor and inconsequential change of a word or two to harmonize the whole.

In the remaining seven sections, certain new features are proposed. In general these are designed: (1) to do away with apex litigation as regards lode claims hereafter located by giving such new claims no extra-lateral

rights; (2) to open the way to development of large irregular bodies of ore such as the so-called porphyry coppers and especially deeply buried orebodies; (3) to force lands to patent; (4) to give permission to pay cash in lieu of assessment work.

As to the first-mentioned proposal, there is now little difference of opinion as to the time having come when it will be wise to change from the old system of extra-lateral rights. The number disposed to argue for the old system is distinctly in the minority, provided, as is most carefully done in the draft submitted, that existing rights be not abridged, and that the change to the vertical boundary system be made in such way as to introduce the minimum of confusion. The Committee, following the analogy of the placer law long in use, proposed a 40-acre claim with permission to locate by 10-acre subdivisions, and, again following the existing placer law, proposed that where the land has been surveyed the location should be by land lines. This latter suggestion in particular has aroused vehement opposition. I cannot imagine that any one considers the particular suggestions vital, even though much good argument can be rallied to its support. Since it seems clear that the miners see in this an undue hardship, it is unimportant. If the miners prefer to locate their claims without regard to land surveys and cardinal points there is no compelling reason for urging a contrary system. The miner will have to pay for patent surveys in every case, whereas under the system proposed he would in places have been relieved of this expense, but apparently the prospectors in particular think it worth the difference and this is a matter in which they mainly are concerned. In your issue of November 19, Messrs. R. A. Dean and others discuss this matter and incidentally show that they are under a misapprehension. "Doubling the size of the mining claims" could not work hardship in the way suggested, since the proposed law allows location by lots of 10 acres, about equal to a half-claim as claims are now laid out, and permits assessment work to be done on the basis of acreage. As the law now stands, it is necessary to do $100 worth of work on each claim, even though the actual ground not covered by previous locations is but a small fraction of a claim. Under the proposed law, the prospector would only do assessment work in proportion to the actual acreage he gets; under the present, he is required to do it by claims regardless of how much land he really gets. Substitution of a square claim with vertical boundaries is the essential reform. The size of the claim and how it be located is a minor detail.

The second object that the Committee had in mind in proposing changes was to open the way to simpler procedure in acquirement of title to the large irregular orebodies, and especially those under a deep cap. Such title must be obtainable in the future if the industry is to prosper. As Mr. Dean and his friends say, "prospectors do not take up a claim unless there is an outcrop or some ore in sight", but there is much ore that does not outcrop and that accordingly the prospector is not equipped to find. There is nothing in the proposed new law to prevent any prospector from taking up any claim on which he found an outcrop; why should he object to others using other means to find ore on other lands? It is proposed to open the way to do this by allowing a temporary possessory title to lands while the deep prospecting necessary to discovery is under way. Under certain limitations also the results of drilling are to be recognized as constituting discovery. Some such system as this must be created if the deep orebodies are to be developed honestly. No one familiar with the actual practice at present can have any doubt that there is now no adequate legal system for acquiring title to lands in the amount and situation needed for financing the development of the larger orebodies where they do not outcrop. Title is acquired through subterfuge and elaborate legal fiction because it is the only way to do it. Men honestly trying to open such deposits have been put to large uneconomical expense and laid open to blackmail because the public as a whole has been too ignorant or too lazy to create a simple honest way to the end desired. Let us do away with pretense and permit miners to be honest in legal matters as they are in life.

The suggestion that a limit be put to the time that land be held without discovery is certainly sound. Whether it is equally wise to set a time within which the claimant after discovery proceed to patent is a matter for debate, and especially what limit, if any, shall be established. The object of forcing claimants to go to patent is to convert public land into private land. So long as it is public land neither Federal nor State governments can force the land into use but when it once becomes private land the State may, if it choose, use its taxing power to compel the owner to mine or give up the land. This is a drastic suggestion. If any such procedure be adopted it should only be as a result of determination by the people in the State concerned. Forcing lands to patent gets the Federal government out of the way and practically gives the people of the Western States authority which they now have only to a limited degree. Whether having it fully they would care to use it would be for them to decide. So far as the United States is concerned, provided there be an adequate system of registration of claims, it is a matter of indifference whether the claimant goes to patent or continues to do assessment work, since in either case the claimant's title is valid, where other provisions of the law have been fulfilled.

The fourth change proposed has given rise to odd misunderstandings. It is merely that when and where a claimant desires to do so he may pay cash to the Government in lieu of doing assessment work. It is permissive only, and anyone who prefers to hold his claim by doing assessment work would be fully entitled to do so. The object of the provision, which as it happens is also now before the Congress in another bill, is to open a way to avoid doing assessment work where it is clearly unnecessary and wasteful. There are, for example, certain oil-shale claims in Colorado where the shale is so fully exposed that no additional test-pitting is necessary or desirable, and under present law there is, in this case, no other beneficial work to be done. The proposal is that the claimant may, if he choose, deposit money in lieu of as-

sessment with the Secretary of the Interior in a separate mineral development fund which must be spent by the Secretary for the benefit of the industry and as nearly as may be within the district in which the claims lie. The object is to permit such money to be used to build roads into the district or for some other general purpose equally beneficial.

The object of this certainly is not to create a vast fund "with which to operate nationalized mines", as suggested orally by one highly imaginative individual. If the object is not defined with sufficient clearness, the phraseology should be altered, but I can see no good reason for denying such a privilege to anyone who wants to use it. It is hardly to be supposed that there will be many checks for $100 sent to the Secretary so long as it continues possible to contract assessment work at $25 per claim.

I have sketched briefly herein the purpose back of the principal changes proposed and have tried to remove some of the misapprehensions that have arisen. Other objections have been urged, but they are mainly as to details, and a careful reading of the proposed law will, I think, remove most of them. In any event the matter is now before the House Committee on Mines and Mining and the Chairman of that Committee, Hon. M. E. Rhodes, has publicly expressed a wish that miners and others interested would give him the benefit of their advice in the matter. The whole matter is up before a friendly impartial committee, and those most concerned have a real opportunity to make their influence felt. Unless they do so, nothing will be done, and in due course the mining laws will be codified as a routine matter by a body of lawyers who may or may not have any real knowledge of the actual conditions under which mines are found, developed, financed, and operated.

H. Foster Bain.

Washington, D. C., November 26.

The Editor:

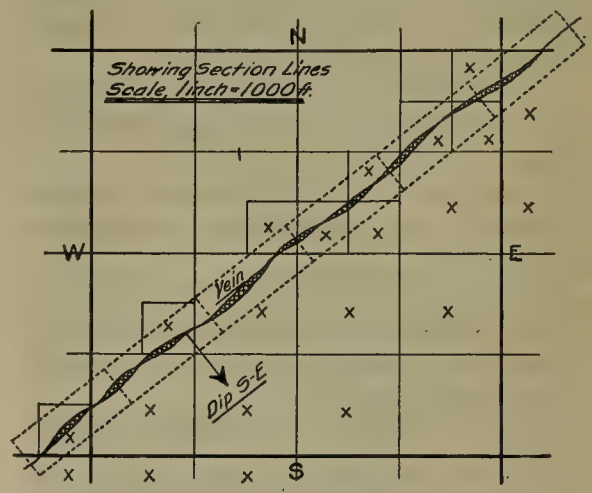
Sir—H. R. 7736, entitled 'United States Mining Act', now in the House Committee on Mines and Mining, contains much that appears to threaten the mining industry; therefore, the undersigned respectfully beg your earnest attention to this protest against its passage.

While not admitting the need of any extensive revision of the present mining statutes, yet if such should be undertaken, and if our mineral resources are to be discovered and utilized, it is of paramount importance that the prospector be encouraged and protected to the utmost degree.

In the opinions of the members of this Association, H. R. 7736 not only fails to accomplish this protection and encouragement but it also actually introduces fresh complications and imposes new and unnecessary hardships, besides requiring that the usual gamut of the courts be run, whereas the existing laws have already been interpreted and are now well and generally understood.

Objection is specifically made to the following sections and sub-sections of H. R. 7736, namely, Section 5-A, B, and C; Sections 6 and 7; and Section 13-A.

Section 5-A. Emphatic objection is made to this section for the following reasons: To require a prospector, or locator, to stake his claims in conformity with the cardinal lines of public-land surveys argues an ignorance of the practical difficulties that would be introduced by such a system. Principal among these may be mentioned, first, the usual difficulty in quickly locating public-survey corners; second, on unsurveyed land, the impracticability of locating claims by means of cardinal lines that shall even approximately agree with the definite lines of a final and subsequent public survey; third, and especially in rugged, broken country, covered with forests and brush perhaps, the impracticability of staking claims on veins that meander obliquely across a checkerboard of cardinal lines so as to guarantee possession of valuable portions of those veins on their dip, particularly when groups are limited to 160 acres. (See sketch attached.)



SKETCH SHOWING METHOD OF LOCATING MINING CLAIMS UNDER PROPOSED LAW, COMPARED WITH PRESENT SYSTEM, AS INDICATED BY THE DOTTED LINES. TO POSSESS A VEIN STRIKING AS ABOVE AND HAVING A FLAT DIP, THE TRACTS MARKED WITH A CROSS WOULD BE NEEDED UNDER THIS NEW BILL.

The prospector, or locator, is seldom or never a surveyor, nor can he be expected to employ one to aid him in the rush and excitement of staking new discoveries. Even under the present simple system of locating claims, the obstacles to be met are frequently many and harassing. In British Columbia, the square location may be made with one side parallel to the vein—not with sides running due north, south, east, and west—thereby greatly simplifying matters and guaranteeing possession of valuable portions of the vein on its dip.

As to subdivision B, of Section 5, this Association considers it to be one of the most vicious pieces of legislation ever proposed for the regulation of land-holdings.

While it is conceded that some well-guarded provision

should be made by which territory lacking visible signs of valuable minerals may be honestly prospected for suspected deposits, yet to throw land open to location for five years without discovery and with no more safeguards against fraud than are proposed in this sub-section, would most certainly result in the immediate plastering of vast acreages with blackmailing and obstructing locations, with the further net result of retarding mining development indefinitely.

Subdivision C, Section 5, is objectionable because it compels the filing of location notices and proofs of assessment work in the United States Land Office only. The same objection obtains in other sections of this bill wherein the Land Office is mentioned in this connection.

The locator of a mining claim should be permitted to file his notices and proofs of assessment work in the office of the County Recorder of the county in which his locations are made, as at present; but, it should be mandatory upon the Recorder to file, immediately, in the District Land Office, a copy of every such location in order to prevent the interferences that now arise.

U. S. Land Offices are often far distant from mineral locations, and the prospector, locator, or owner should not be compelled to travel those distances to consult the records.

Subdivision B, Section 6, is objectionable as regards the acceptance of a cash payment in lieu of actual assessment work on a claim.

This Association believes that too many claims lie undeveloped because of this privilege. It is also believed that lapsed claims should not be re-locatable by delinquent owners, or their representatives, for a period of one year from the date of lapse.

Section 7. Thirty-five or forty years ago, an abolishment of the extra-lateral right would have prevented considerable costly litigation and could have been accomplished without confusion; certainly it would have been of great benefit. But that was before most of the great camps of the United States had been discovered. Now, however, it is doubtful if there remains unprospected any considerable region, except Alaska, within which an important camp is likely to arise, or where the square location, bounded by vertical planes, could prove of any advantage whatsoever. On the contrary, in the re-location of lapsed claims in the midst of present locations it would not only prove useless but might well cause confusion.

Furthermore, the law of the apex is now so well understood by all mining men that locations are made with it in view and its hazard is taken with open eyes. Consequently, this Association is strongly opposed to any tampering with the well-established extra-lateral right at this late day, especially since no enactment can be retroactive.

Referring to Section 13-A, this Association objects to any change in the present method of obtaining mill-sites.

In conclusion, the undersigned is of the opinion that most mining men prefer evils that they know, if such there be, to those they know not of; moreover, that the mining industry as a whole will soon recover from the present depression, and thrive better in future, if permitted to work out its many problems unhampered at this time by legislation of any sort.

NORTHWEST MINING ASSOCIATION,
By G. B. DENNIS, President.
F. C. BAILEY, Secretary.

Spokane, Washington, November 19.

The Editor:

Sir—In the discussions of the proposed new mining law, very few of the writers give any line-up of the kind of a code they prefer.

Why object to locating claims without a discovery? What show would a prospector have to acquire a claim, when a stampede is on, if he stopped to make a discovery before he located? While he was looking for mineral, others would post a notice of location, and rush off to record it, and he would have no recourse. If he found mineral, the others would say they saw it first.

It is a well-known fact that most of the best placer claims were staked by stampeders, who staked as near the discovery as they could, or took what was left, and never stopped to see if there was mineral on the claim; they rushed to the Recorder's office and filed their location notice. The same can be said of quartz claims.

The new law should change the name 'discovery monument' to 'location monument'.

How about a discovery before locating in a level desert country where the veins are covered from 10 to 100 feet with soil or wash? The surface would be classed as agricultural land. In such a district a bonanza silver strike was made, after 20 years or more prospecting, that will probably prove to be the best made in California. And there are other districts of the same description. How can such ground be prospected by a prospector if he is only able to sink one hole 10 feet in a year's time and is not allowed to locate until he finds mineral?

So long as a locator does his legal assessment work (which should not be too heavy) on his own claim or group of claims, he should be allowed to hold them, and when able, if he so desires, obtain a U. S. patent.

There should be a limit to the number of claims one could locate in a new district, but one should be allowed to hold and group all one can buy, or all one can stake in an old district, as it would help the owners of low-grade properties to dispose of them.

As to holding patented or unpatented claims and not working them: to force the owners of claims to operate would react upon the prospector, as he would only be able to sell a developed, or bonanza, claim.

It is a well-known fact that in mining one can easily get into a financial difficulty that may cause suspension of work for an indefinite time; and who would invest in a prospect or a partly developed mine if compelled to operate at a loss or lose their claims, when if allowed to bide their time they would be able to make a success of the venture and get their money back? In many mining districts there are mines or groups of claims that are not being worked. In some of them the owners have

them all tied up in that way, their money having been spent in development work, etc., but they lacked sufficient funds to put the property on a paying basis. Would it help prospecting if they are compelled to turn their claims back to the Government, and lose all they have invested? Not on your life! There are many gold properties that can be, and will be, operated when the time is right; so why confiscate them?

Let locations be made without discovery, and by all means let a patent be obtained at less expense to the claim-owner.

W. K. WHITMORE.

Mojave, California, November 22.

A Definition of Engineering

The Editor:

Sir—In a recent conversation with several engineers a friendly argument arose as to the precise meaning of the title 'engineer'. Originally the name was applied to a man who made an engine or machine of any kind; later it was more generally used to signify the man who operated an engine—an engine-driver as he is called in most English-speaking countries outside the United States. However, the man whom we may call for the purpose of discussion a 'professional' engineer is a different person entirely from the engine-driver; it is to him that this discussion refers. Ours is an age of specialization. The arts comprehended by the term engineering are so diversified that there are hundreds of kinds of engineers, and in the accomplishment of any specific engineering feat or enterprise as many as a dozen specialists may participate. For this reason it is convenient to describe an engineer as one who engages in some specific branch of engineering and then attempt to define 'engineering', as being a more comprehensive term. I mean by this that the definition will embrace a wider range of work than is ordinarily undertaken by any individual engineer today. My suggestion, to which I invite criticism, is this:

"Engineering is the devising of plans and the contriving of means and methods for the creation of something having material value to mankind, by the utilization of machines, commodities, human labor, and the forces of nature".

I shall anticipate a few of the objections that may be raised to this definition and endeavor to answer them as well as I can. In the first place the definition is exceedingly comprehensive; a tailor, a farmer, or a cook might qualify as an engineer under the terms of it; but if they employ 'ingenuity' (derived from the same root as 'engineer') in accomplishing their work, can they be denied a place in the general classification of engineer? Why not a clothing or an agricultural or a culinary engineer as well as an automobile, a mining, or a chemical engineer; and why not much better than, for example, an efficiency engineer or a publicity engineer, or a sales engineer. The first term is ridiculous; the two others, at least, have arisen, I believe, from the fact that men who once engaged in engineering have undertaken work that lacks the essentials of engineering, but are disinclined to abandon their former designation entirely. That is not to say that a first-class engineer may not be a good salesman; but when he is selling he is not doing engineering any more than he would be if he were playing golf. At the same time being a good engineer might make him both a better salesman and a better golfer. A good engineer must be efficient, just as a good accountant or stenographer must be efficient, but the principles of efficiency are the same everywhere, and there is little more justification for the title of 'efficiency engineer' than there is for those of 'efficiency accountant' or 'efficiency stenographer'. Engineer has become a name to conjure with! One of the problems in formulating a good definition is to qualify the terms in such a way as to exclude work that is not essentially engineering. How shall we eliminate the tailor?

Several of the men with whom I discussed the definition demur at the inclusion of the idea that human labor is one of the instruments of engineering. They hold that the engineer is concerned with inanimate things only. I am inclined to take the view that accomplishment is as essentially a part of engineering as is conception. Architecture, for instance, in the generally accepted sense, lacks one of the essentials of engineering. No tangible result can be obtained without some expenditure of human energy or labor. Suppose that our tailor measures a customer for a suit of clothes; decides upon the style of cut that will become him; selects the fabrics for the suit itself and for the lining; obtains the thread, the buttons, and the sewing-machine; even draws on paper the patterns for each piece. All this has been characteristically the work of a tailor; but if the particular tailor were to stop here he might just as well never have started, so far as the customer is concerned, because the customer himself cannot finish the job; and what he needs is a suit of clothes that is ready to wear. From a practical standpoint no tailoring has been accomplished. In the same way the essential part of engineering is the creation of some tangible thing of practical or material value, and that cannot be accomplished without the application of human labor.

Even if it be conceded for the sake of argument that the rôle of the engineer is only to plan and not to execute, he must still take human work into account, for according to our present standards an adequate 'design' includes a schedule of the approximate kind and number of men that will be required during consecutive periods in the construction so that progress in each branch of the work shall be made at the exact rate predetermined as being best. Definite plans must be made to co-ordinate labor.

Suppose that an engineer were to undertake the erection of two large earthen dams, one in Nevada, the other in the interior of China. The completed structures would be identical, the engineering problems would be entirely different, largely because in China the work would be done by coolies carrying the earth in baskets on their heads. The point that I wish to make is this: whereas

the engineer need not necessarily deal with the personalities of men as individuals, he cannot ignore their collective abilities, customs, and other attributes.

The all-round engineer need not be a 'welfare' worker; nor a diplomatic 'handler' of men; but human effort and labor is one of the important tools with which he works. He cannot leave it out of his calculations. If his enterprise is conducted in an isolated region, adequate provision for the lodging and boarding of the men who are to do the work is an essential element of the engineer's problem; some solution must be an integral part of his plan. A few engineers insist that the supplying of mere subsistence is not enough, and that the promotion of desirable 'human relations' is part of engineering. Frankly, I am not inclined to go so far as that.

In my definition I have implied that the object of engineering is to promote the material welfare of mankind. My friends protest, and say that the prime object of engineering effort is to earn money, first, for the employers or clients of the engineer; and, second, for the engineer himself. With this I am unable to agree. In the first place, unless the product of an engineering undertaking or enterprise is of material value to mankind, unless it promotes the general welfare of society, that undertaking or enterprise cannot earn money for its backers. Copper is converted into trolley-wires and iron into steel-rails; an electric railroad is a convenience and promotes the welfare of mankind, and for that reason copper and iron ores are mined from the earth. A steamship is a valuable asset to mankind because it permits the hauling of commodities and the travel of passengers between continents; for that reason steamships are constructed at great cost. Economic laws provide that financial compensation shall be accorded to those rendering a service, but if the production of copper and the building of ships did not render a definite material service to mankind, not any would be mined and none would be built. The welfare of mankind is fundamental; the financial profit is incidental.

Let us presume that for reasons of their own a firm of engineers volunteered to erect some useful public structure without profit to themselves; that is, they would merely be reimbursed for the actual cash outlay that they made. Would the structure be any less the result of engineering skill? would the work done be something else than engineering merely because no financial profit accrued to the engineers?

It seems to me that those who contend that the purpose of engineering is financial profit confuse two things, namely, the *purpose* of the undertaking and the *motive* of those who accomplish it. With the motives of individuals we are not concerned; they may or may not include financial gain, but if they do they must necessarily be predicated upon a material service to mankind. That is the *sine qua non* of an engineering project. There is no suggestion of altruism in this argument; it is based on purely practical considerations.

Considering for a moment the viewpoint of the individual engineer: it is necessary, sometimes inconveniently to be sure, that a man eat at comparatively frequent intervals, and that he clothe himself if he desires to mingle unmolested with civilized people; a roof over his head adds greatly to his comfort, if it be not vitally essential, and for these reason a great many engineers find it necessary to exchange their services for money. But I venture to suggest that, if they were given an annuity, sufficient to provide for their comfort, in lieu of any further salary or fee, a large majority of our really able engineers would continue to work as hard as ever with no thought of reward other than the hope of achieving something worth-while for the future welfare of their fellowmen. Do our statesmen, our railroad presidents, our preachers, our teachers, our writers, our composers, our scientists, our painters, our singers, our actors, our base-ball players work merely because of the money they get? Some do, many of the best do not; the same may be said of engineers. All this, however, is beside the point; the motives of individuals are diverse and complex; they do not count.

All *useful* occupations in the world necessarily promote the welfare of mankind—it may be the moral welfare, the mental welfare, the material welfare, or a combination of these. Engineering has as its object the advancement of our material welfare; in the definition, the more signaficant word is 'material', for that it is that distinguishes engineering from a large number of other kinds of endeavor.

As I have already stated, I offer this definition, tentatively, as a basis for discussion. I trust that others will feel free either to defend or to demolish it.

San Francisco, October 7. A. B. Parsons.

For some years one large copper-mining company has been experimenting with water-stopers and now has more than 200 self-rotating machines of this type in use, says D. Harrington, of the U. S. Bureau of Mines. Two of its mines for a period of about a year prior to the shut-down in April 1921 had wholly discontinued the use of dry-stopers. At present, in its only operating mine, wet-stopers alone are being used. Three kinds of self-rotating wet-stopers have been tried and all pronounced commercially successful. All are applicable to the drilling of any kind of ground in the district—hard to soft, solid to broken. This flexibility is due largely to the brake with which the machines are equipped. The self-rotating wet-stopers drill nearly double (frequently more than double) the number of inches per minute drilled by dry-stopers. Moreover, they prevent the formation of dust in the drill-hole, and the water used wets the surrounding rock and timber sufficiently to lay at least part of the dust in broken ore, on timbers, in chutes, and also materially decreases the temperature of hot places. While the first cost of the machines is nearly double that of dry-drills and the cost of upkeep more than double that of dry-drills, yet the company referred to, after a thorough trial extending over two years, has determined to adopt wet-stopers as standard equipment in its mines. Progressive mine operators should see that wet-stopers are given a thorough and a fair trial.

CRUSHING PLANT OF THE NEW CORNELIA COPPER COMPANY

Development of the Disc-Crusher and Leaching Practice

By A. W. Allen

In the preliminary tests in the United States on the ore from Chuquicamata, Chile, mechanical as well as chemical problems were investigated, an important subject being the secondary crushing of the material to a size that would ensure cheap and effective leaching. The original plans called for the use of 72-in. rolls for intermediate reduction from 5 in. (as it came from the McCully gyratory crusher) to 1½ in. (for delivery to the 54 by 20-in. high-speed rolls). Tests made in New Jersey in the summer of 1913 caused a change of plan, 48-in. horizontal disc-crushers being substituted for the 72-in. rolls. It was found that the first cost was lower and the shipping weight was cut in half—an important consideration in view of the distance between the mine and the factory.

The second change in favor of disc-crushers was made after the first crushing-unit had been in operation in Chile, and when complete data were available. It was decided then to discard the high-speed rolls and to replace them with vertical disc-crushers, so that the ultimate as well as the penultimate reduction would be accomplished by these machines. At the time of my recent visit a mine output of about 13,000 tons per day was being reduced by means of eight 48-in. horizontal disc-crushers from over 3 to under 1½ in., and by 24 vertical disc-crushers from 1½ in. to a product that contained only about 12% plus 0.371 in. The machines are producing an ideal mixture for leaching; the change in favor of the disc-crusher has been due to an appreciation of its suitability and efficiency; personal likes and dislikes, bias or prejudice, have little weight in connection with decisions of an important nature in which first cost, operating cost, repair cost, renewal cost, and suitability of product are factors of importance. Therefore I was pleased to receive additional justification for an impression that I had held for many years that the disc-crusher operates on a principle that is unusually sound; the ore travels in the direction of an increasing discharge-area as it is being reduced in size, thus obviating the undesirable abrasion that takes place in the majority of crushing machines. If the operation of rolls or swing-jaw crushers for comparatively fine reduction be visualized, it will be understood that there is a great deal of compression among individual particles of the ore that may have been reduced already to a size that would justify discharge. But before such particles can reach the exit they are pressed between other, larger particles, with the result that an undesirable amount of abrasion and sliming ensues. This is an important consideration in leaching, where the avoidance of slime is desired, and where an undue production of slimed ore may make the process economically impossible.

The credit for the invention of the disc-crusher belongs to Edgar B. Symons, who built a 24-in. machine in 1908. The first unit developed structural weaknesses, and various modifications in design were proposed and adopted. The crusher was first used for the production of crushed gravel by a company in the State of Pennsylvania; its work was appreciated, and more machines were added. Designs were then made for several alternative sizes—18-, 36-, and 48-in. In 1913 the firm of Chalmers & Williams began to manufacture the crushers for the inventor, and later acquired the exclusive rights in the United States and in some foreign countries. The

original machines were made with a horizontal shaft, vertical discs, and a single driving pulley, as shown in Fig. 1. In this model, the eccentric bearing that carried the tail end of the inner shaft was stationary; the pulley was connected direct to the outer shaft, which communicated motion by friction to the inner shaft. The most important improvement was to adopt a second pulley, the hub of which was designed with a bearing on the inside for the tail end of the inner shaft. This is a distinctive feature of the machines now in use. The two pulleys are driven in opposite directions; the improvement in crushing is such that it is possible to revolve the main pulley at a much lower speed than formerly, bearings, all of which are lubricated by means of circulating oil delivered by a pump (19); the stream of oil also lubricates the eccentric bearings (8) of the inner shaft. Adjustment shims are provided (30 to 35A) to regulate the size of the product or to compensate for the wear of the discs. The outer disc is held in position by the ring-nut (67); the inner disc is secured to the inner shaft, as shown in Fig. 3. A screw is used to lock and unlock a ratchet. In the illustration the inner disc is shown in place, but the ratchet set-screw is in the position in which it is possible to remove the ratchet-screw. By unscrewing the set-screw (68) the spring brings the ratchets together until they engage, so that

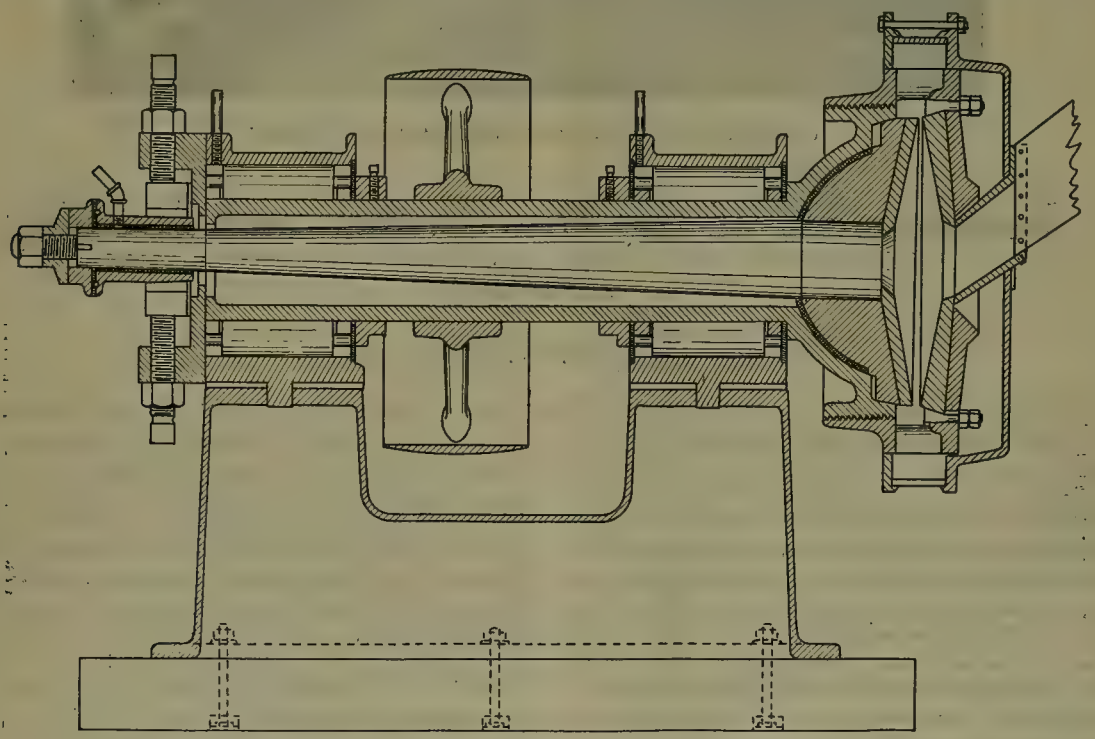


FIG. 1. THE ORIGINAL DISC-CRUSHER, KNOWN AS THE SYMONS SAND MACHINE

and to obtain greater crushing results and avoid excessive wear.

By referring to the accompanying drawing (Fig. 2), it will be seen that, at the extreme left, the pulley has an eccentric hub, by which a lateral motion is given to the inner shaft (28). This is connected with the inner disc (24), which is attached to a cast-iron babbitted ball behind a special ball-and-socket bearing. The main crushing load and the strain incidental thereto are sustained by the ball-and-socket bearing, for which a large surface is provided. Loose motion can be eliminated by tightening a nut (69). The outer shaft, which is revolved by a pulley (15), operates in the same direction and at the same speed as the inner shaft; it connects, by means of spider-bolts (41) and lock-nuts (77) with the outer disc (23), in the centre of which a delivery-spout (C0) is placed. This shaft is supported by appropriate the disc and ratchet-screw cannot turn when the crusher is in operation. The discs are given an even support by means of a bed of zinc, which is poured when molten into the space between the disc and the cast-iron ball, in the one case, and between the disc and the combination spider and plate in the other case.

'Minimum exit' in the following table is the distance between discs at the maximum opening. The figures of capacity for the 18-in. machine represent an average for ordinary hard rock. The higher of the two figures given for the 24-in. machine is invariably obtained in practice, and is often exceeded. With the two largest types the capacities given may be considered subnormal so far as rock of average hardness is concerned. Horsepower requirements never exceed the maximum given and are seldom more than an average of the two extremes mentioned. A higher consumption of power is

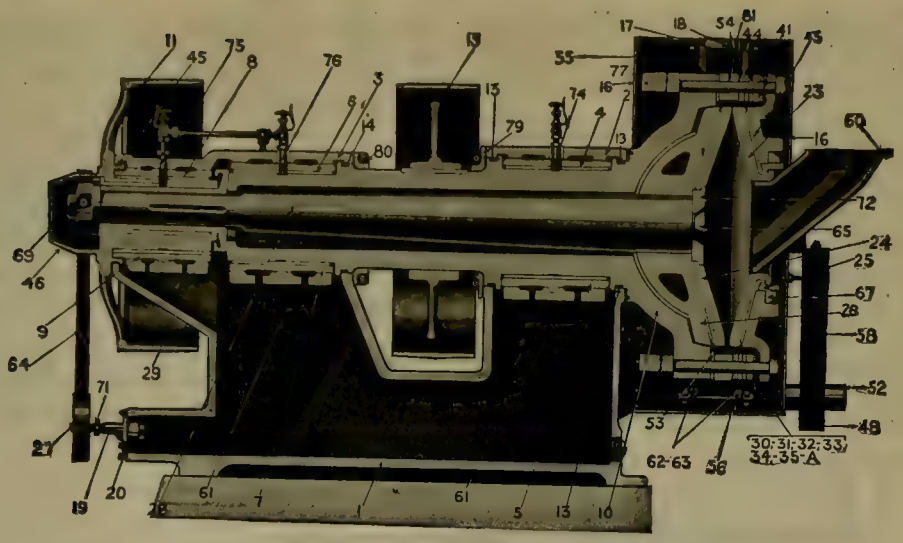


FIG. 2. SECTIONAL VIEW OF 36- AND 48-IN. SYMONS HORIZONTAL DISC-CRUSHER

noted sometimes where the rock crushed contains an excessive proportion of material that cakes and tends to choke the machine.

The two driving-pulleys run in opposite directions. The revolutions per minute of the driving and eccentric pulleys, respectively, are as follows: 18-in. crusher, 200 and 450; 24-in. crusher, 200 and 400; 36-in. crusher, 133 and 300; and 48-in. crusher, 100 and 250. Other details follow:

Size of disc, inches	18	24	36	48
Size of feed, inches	1½	2½	3½	6½
Minimum exit opening for best results, inches	⅜	½	¾	1
Horse-power required	12 to 18	18 to 25	30 to 40	50 to 60
Capacity in tons per hour to pass a ring of:				
⅜ in.	5 to 8	.....	.....	.....
½ "	8 to 10	12 to 15	.....	.....
¾ "	10 to 12	18 to 20	25 to 30	.....
1 "	12 to 15	20 to 25	30 to 45	45 to 60
1½ "	.....	25 to 30	45 to 60	60 to 80
2 "	.....	.....	50 to 65	80 to 100
2½ "	.....	.....	.....	100 to 120

The disc-crusher is used almost entirely in the successive reduction of ore and rock to comparatively small sizes, and usually takes the discharge of swing-jaw crushers or gyratories. In comparison with gyratories for stage-reduction, it takes less head-room; in addition, it is asserted, a greater tonnage of material can be crushed per unit of power expended. This is due undoubtedly to the fact that the ore during crushing travels toward an increasing discharge-area, and not toward a decreasing one, as with the gyratory. As compared with jaw-crushers, the disc machine is handicapped by the fact that the possible range of reduction is considerably lower, but this is more than offset in most cases by the character of the product and the maintenance of a uniformity in this respect throughout the entire life of the wearing parts of the machine. The same favorable factor constitutes a point of superiority in the disc-crusher

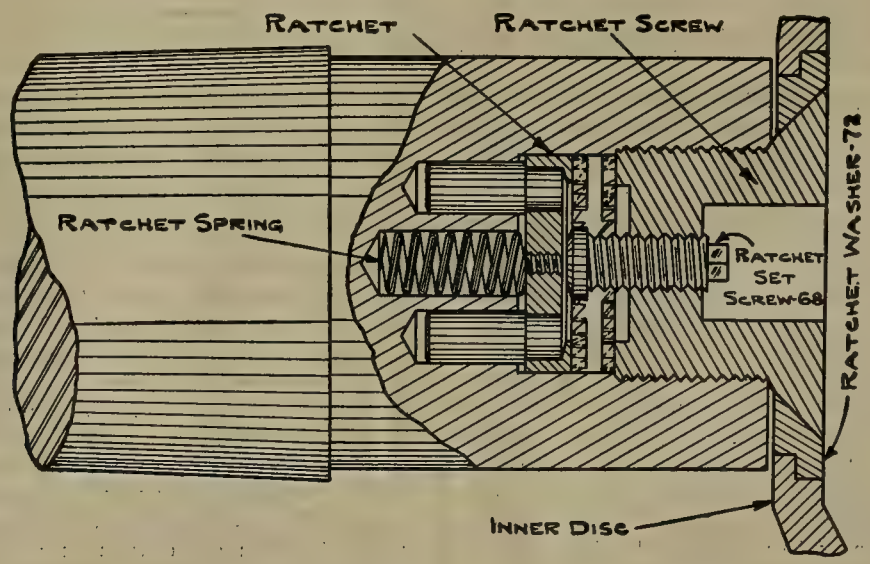


FIG. 3. METHOD OF SECURING CRUSHING-DISC TO INNER SHAFT.

over rolls. When using the latter the problems of corrugation and grooving are insistent, and the character of the product changes according to the condition of the shells.

The principle on which the vertical disc-crusher operates is essentially the same as that of the horizontal machine. It will be seen by referring to the accompanying illustration (Fig. 4) that the disc-shafts are vertical. The principal difference between the horizontal and vertical machines is that the size of the product from the latter is controlled by the minimum discharge-opening between the discs, whereas the product from the vertical-disc machine is gauged by the maximum opening between the discs. In this respect 'maximum' and 'minimum' are terms referring to the variations in distance between the discs at opposite sides when the crusher is in operation, and does not refer in any way to possible changes that may be made in the apertures by the insertion of adjustment shims.

In the vertical machine the ore or other material to be crushed is fed through the centre of the upper disc and falls onto the lower disc; it is then thrown toward the periphery by centrifugal force, where it is crushed between them. The discs, as in the other type of machine, travel at similar speeds and in the same direction. It is pertinent to mention that the distribution of ore in the vertical machine is more perfect than with the other type, in which gravity interferes to a slight extent with the direction of flow of the crushed rock. In the vertical machine the material on the lower plate cannot escape until the two discs have come together one or more times; every particle must be reduced to the size of the minimum opening before it can be released. This facilitates relatively fine grinding. For example, when crushing to ¼ in., the minimum exit is fixed at this dimension, the maximum opening being about ¾ inch.

The vertical machines are only made in the 48-in. size, but the upper disc can be changed to suit varying conditions. Thus, for example, for coarse crushing, an upper disc is made that permits the feeding of 4½-in. material, the product from which will all pass a ½-in. opening. By altering the adjustment, a 1-in. or a 1¼-in. product can be reduced to ¼ in., or even smaller; with yet another type of disc, it can be reduced from 2¼ in. to ⅛ in. The vertical machines are slightly more complicated than those of the alternative type, and more skill is required in making repairs and in effecting adjustments. The standard machines seldom require more than about 50 hp. At the Ajo plant of the New Cornelia Copper Co., a unit of three vertical disc-crushers reduces an average of 100 tons per hour. One crusher takes the discharge from a No. 8 gyratory, set to about 3½ in., the product being passed over two stationary screens and the oversize is crushed in two vertical machines. The final product contains only about 22% on 3-mesh, and only 0.5% on a ½-in. round-hole screen. The ore is hard. During May 1920 the cost of crushing the product from the gyratories in the vertical machines to 3-mesh and finer, including power, repairs, labor, screening, and conveying, was 9 cents per ton. Further reductions are expected when the plant is again in operation and when 'normalcy' returns. Costs for such operations are generally misleading; they vary with the position of the property, the transportation facilities, and the size of the plant. The character of the rock in two different localities may differ to such an extent that the result from the

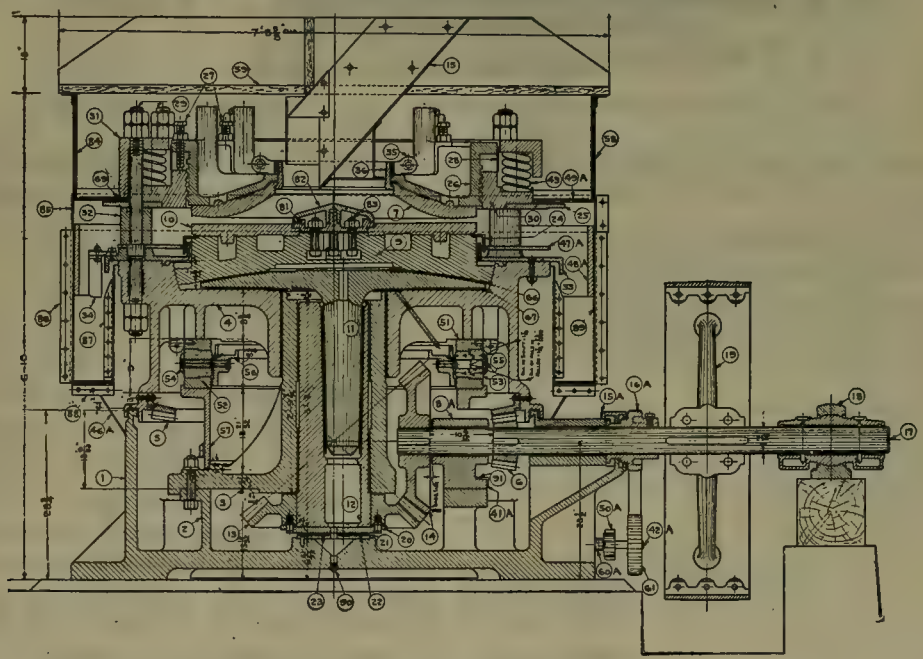


FIG. 4. STANDARD 48-IN. SYMONS VERTICAL DISC-CRUSHER

operation of duplicate plants may indicate a variation of 100% in the cost of crushing. In producing a relatively coarse product, a much greater tonnage can be handled with the same power and with the same steel consumption than would be the case of fine crushing.

The disc-crusher has come into prominence in the mining industry in connection with the beneficiation of low-grade copper ores by leaching. Two great plants, at Ajo, Arizona, and at Chuquicamata, Chile, have adopted the machine entirely for the final reduction of their ores to a size suitable for leaching. The advantages of dry crushing previous to the application of wet methods of extraction are worthy of consideration. It obviates the separation of sand and gravel from slime and colloid—a separation that invariably occurs when water is used in quantity, as it is in all wet-crushing operations. It permits the economical leaching of the whole of the product of the mine in one operation, whereas, if the ore were crushed wet, it would be impossible to remove the excess water and at the same time to leave the slime evenly distributed throughout the mass. Not only would the slime escape proper treatment, but its presence in aggregations would interfere with the satisfactory and even leaching of the sand and the gravel. The alternative would be to isolate the slime by classification and to treat this separately. But slime treatment is expensive and usually inefficient; hence the overwhelming benefit of dry crushing, the even distribution of slime throughout the charge, and the leaching of the whole in large units. It is in connection with leaching that the disc-crushers have been favored, for the freedom of discharge facilitates the quick delivery of material that is crushed to a proper size, and prevents the sliming that too often occurs in other machines. The work at Ajo and at Chuquicamata marks an era of bold advance in the metallurgy of copper; gold is a metal that, next to amalgamation, is being recovered by a leaching process. The dry crushing of ore and its subsequent leaching, as practised at the Ajo and Chuquicamata plants, was developed by cyanide metallurgists many years ago. In India, in Rhodesia, and in South Dakota the gold ores were crushed to ¼ in. or so, and the entire mass was leached. In the American plant, the extraction was only 70%; but this result compares favorably with the extraction of 90% obtained at Chuquicamata, when it is realized that the gold content of the South Dakota ore averaged only about 0.00035% of the mass in the first instance, whereas at Chuquicamata the copper contents of the ore average about 2%. Further, recent mechanical advances, particularly in connection with crushing, have indicated the correct method of preparation of the ore for leaching. If the great copper plants today were obliged to rely on the crushing equipment available at the time of the operation of the Indian, Rhodesian, or American dry-crushing, direct-leaching plants, the results might well be doubted. It is probable, if modern ideas of crushing and leaching were now applied to material from many low-grade gold-ore deposits, that it might be found that an opening existed for profitable exploitation by the utilization of the facilities that now exist for the efficient crushing, the uniform distribution of the dry material, and the leaching of the whole on a large scale. Although little is known about colloids, sufficient empirical knowledge has been gained to show that a preliminary baking treatment may serve to facilitate and cheapen preliminary crushing and will render the colloid slime innocuous. Here again there is a field for research in connection with leaching, which in some cases may be made feasible by the preliminary treatment of the ore with sufficient heat to minimize susbequent trouble from slime. If coarse gold be present in such ores it is obvious that the milling in water and the attendant trouble of the separation of the slime from the sand may be avoided by practising amalgamation after cyanidation. There are disadvantages, but they may well outweigh the advantages in such an exceptional case. In this, again, there has been little research. If gold be not dissolved by the cyanide, it is at least in excellent condition for amalgamation.

A third and equally important field for the application of scientific leaching is in connection with the treatment of the billions of tons of low-grade caliche and ripio on the Chilean pampa. Here again it has been demonstrated that disc-crushing of the material from the ripio dumps or from the salitreras, to a comparatively fine mesh, as in copper-leaching practice, or as in the early work of the cyanide metallurgists, is a satisfactory preliminary to an excellent extraction of the nitrate by the application of leaching principles that take into consideration the peculiar problems that have to be faced. Experience breeds assurance. The leaching tests on Chuquicamata ores were commenced with 100-kilogramme lots; these were then increased to 2000 kg., and then to 14,000 kg. The results from the 14-ton experimental unit gave all the information that was needed for the design of the 10,000-ton plant. The results on a large scale duplicated the experimental results. Also in the case of the Ajo plant, the experimental work was commenced on a small scale; then 1-ton lots were treated, then 40-ton lots. With the information obtained a jump was made to a full-sized plant of 5000-ton units.

One of the great advantages of leaching is that an extraction obtained on one square foot of material can be duplicated with a million square feet, if necessary, provided that the depth is the same in each case, and the fundamental principles of leaching practice are observed. The work on the Chilean nitrate pampa was commenced with small tests; an oil-can was first used to determine comparative solubility of material crushed to various sizes. The second (single) test was made in a 5-in. pipe, about 10 ft. high, to prove the practicability of leaching through an economic depth of the crushed caliche. The third series of tests was made in a piece of round, iron boiler-stack, of about the same height as in the previous tests, 11 in. diam., and capable of holding about a quarter of a ton. The fourth series of tests was made in a square column, of riveted steel-plate; it held about half a ton and was about the same depth as the other columns. The

final test was made on 90 tons; and by this it was proved that identical results could be obtained, assuming the maintenance of the necessary conditions, whether the area of material leached was 1 square foot or 1000 sq. ft. It is all a question of the recognition of the fundamental principles of leaching, as developed by the cyanide metallurgists and the copper metallurgists, and as applied to a mixture of particles of widely differing size. Uneven distribution in the leaching-vat, for instance, will cause channeling and inefficient extraction. The fault lies not with the leaching process but comes as a result of a neglect to appreciate the essential requirements for uniform percolation. From the 90-ton unit to a 1000-ton or even a 5000-ton unit would have been a logical step in Chile; but it has been hard to convince the operators on the pampa that leaching can only be successful when fundamental principles are recognized. A great deal of money has been spent and much time has been wasted, for instance, in an endeavor to show that a homogeneous charge preparatory to leaching is unnecessary, that the advocacy of such is merely evidence of an adherence to theoretical refinements. Needless to say, the principle holds good, in spite of efforts to disprove it; the point is generally overlooked that such principles were enumerated in the first instance by those who had combined theory with practice, to the neglect of neither. After much insistence it is beginning to be realized that the mechanical distribution, by a system of main and cross-conveyors, constitutes the ideal method of filling a large vat with comparatively finely-crushed and dry material. Some of the 'practical' men of the pampa, the nitrate content of whose ripio dumps speaks for itself, hold out in favor of the tipping of carloads, or the delivery of caliche through a chute, at certain points in the vat, until piles of variable height are formed, down the sides of which the larger lumps slide; but a recognition of the absurdity of this proceeding is inevitable, although the process of enlightenment appears to be slow. Essential facts relating to the fundamental principles of leaching are, however, being recognized on the nitrate pampa. When the practicability of the efficient treatment of low-grade caliche on a large scale is realized, steps will be taken by the government of Chile to reduce the appalling expense, and wastage of national resources, that are now being incurred as a result of the selective mining, sorting, and treatment of high-grade caliche; for this practice involves the discard of large tonnages of nitrate-bearing material that should and could be treated at a profit. Further, the Government needs revenue, and this can best be obtained as a result of the exploitation of the nitrate deposits on an adequate scale and in an efficient manner. When this happens it is probable that the disc-crushed will be used extensively on the pampa, both for the penultimate as well as for the final crushing of the caliche. The adoption of the roll-crusher at any stage is not recommended; experience has shown that it is by no means an ideal machine for the comminution of a soft material for leaching, and for reasons already mentioned.

Success will also depend in large measure on the methods adopted for elevating the crushed caliche and distributing it in the vat; the use of bucket elevators should be avoided; traveling-belt conveyors are preferable; in the majority of cases they can be used in place of bucket elevators. Further, the caliche coming to the plant as a result of average mining operations on the pampa is extraordinarily varied in physical character as well as in nitrate content. It is imperative that it be mixed thoroughly, and distributed evenly in the vat before leaching is commenced; the distribution is best effected also by traveling-belt conveyors. The enumeration of these details will indicate the progress in efficiency that has resulted since the early days of cyaniding a dry-crushed gold-silver ore.

As before mentioned, pampa operators are usually inclined to consider as unnecessary the rigid application of the fundamental principles involving the successful leaching of a mixed product; after a wholesale disregard of elementary reasoning it has been proved on a working scale that slipshod methods may yield a good actual recovery of nitrate. The Chilean nitrate industry has been accustomed to high losses in ripio after Shanks treatment; the amount of nitrate in the dumps that are scattered over the pampa offers conclusive proof of this assertion; but the times are changing rapidly, and it will soon be realized that a satisfactory recovery from a low-grade caliche will ensure the prosperity as well as the continued existence of the industry; and thoughtful technicians who are able to appreciate the fundamentals of efficient leaching will insist that, when percolation has been commenced, the treatment should be carried to a logical conclusion—until a high proportion of the desired soluble has been removed. A disregard of mechanical and physical considerations will make this impossible.

THE minimum temperature required for the roasting of zinc-blende is about 600°C. The most economical temperature to use on low-grade concentrate is between 650 and 725°C. In preparing ore for leaching with sulphuric acid the main object is to obtain as nearly as possible a dead-roast with the minimum formation of ferrite, which is insoluble in dilute sulphuric acid of the strength usually found convenient in an electrolytic plant, according to a paper read by J. T. Ellsworth. Either the oxide- or the sulphate-roast may be used. The furnaces ordinarily used at present are six- or seven-hearth McDougall or Wedge type, fired with coal or oil. These furnaces are best adapted to the sulphate-roast, which consists in exposing the concentrate for 15 hours to a temperature of about 650°C. This roast is necessary when the material treated is high in iron, say around 20%, on account of the more rapid formation of ferrite at higher temperatures. If the iron is around 10% the oxide-roast with a temperature of 700 to 725°C. is preferable, but the time should be lengthened to at least 24 hours in order to lower the proportion of sulphide sufficiently to avoid its concentration and re-handling from the leach residue, which is quite often necessary with the sulphate-roast.

The California Rand Silver Mine—II

Geology, Development, and Mining

By Arthur B. Parsons

The preceding article recounted the story of the discovery, in April 1919, of this remarkable bonanza of silver ore in the old gold-producing district of Randsburg, near the eastern border of Kern county in California, and of the production within 30 months of silver-gold ore having a gross value of 2¼ million dollars, with the payment of nearly a million dollars in dividends. In this article I shall point out, among other things, some of the interesting geological features of the deposit as they have been revealed by the operations of the California Rand company and sundry lessees, as well as by the work of the Randsburg Silver Mining Co., which owns the Coyote claim, adjoining Uranium No. 5, as indicated on the accompanying map of the district (see Fig. 1). A 500-ft. shaft, from the bottom of which cross-cuts have been run both south-east and south-west, has proved the existence of silver-bearing veins underlying the Coyote claim.

Geology of the District. The country-rock in the productive part of the Randsburg district, including both the older gold 'zone' and the newly discovered silver 'zone', is a highly altered schist, which is classified as "a mica-albite schist of probable sedimentary origin" by Frank L. Hess, who made an examination and report on the quadrangle for the U. S. Geological Survey in 1909. An intrusion of granite cuts across the Rand mountains south of Randsburg; it is roughly crescent-shaped, and is several miles long; in places, it is half a mile wide. The Yellow Aster mine, which is credited with a production of $9,000,000 in gold, is situated at the intersection of this granitic intrusion with the axis of the Rand range of mountains. The ore deposits are closely associated with the granite and with numerous adjacent granite-porphyry dikes that, according to Hess, are "probably connected to it". The intrusion of granite can be traced across the country in a south-easterly direction and can be identified immediately north of the California Rand workings.

Hess describes three different types of ore in the schist-granite area; they are: (1) fault-lodes or deposits along faults in crushed schist and granite; (2) stockworks in granite; (3) fissure-veins, containing quartz in varying quantity. Although the rich silver-bearing ore had not been discovered at the time he visited the district, the physical characteristics of the silver deposits are not dissimilar to those which Hess describes, except that, in the silver zone, ore of the stockwork type is found in the altered schist rather than in a rock that can be identified distinctly as granite. In fact, no silver ore has up to this time been found north of the contact of the schist with the regional intrusion of granite. The summary of the deductions that Mr. Hess made regarding the genesis of the ore is interesting. He says: "It seems probable that, after the intrusion of the granite and the granite-porphyry dikes, a large amount of hot water was squeezed from the granite while it was cooling. The water carried silica, gold, silver, iron, sulphur, arsenic, lime, tungsten, and a little tellurium and titanium in solution, and flowed along the faults and shearing planes and through the broken granite. The minerals were deposited wherever chemical reactions took place". All the geologists who have studied the district appear to agree that the large crescent-shaped intrusion of granite was undoubtedly the primary source of the minerals that were deposited in fractures traversing the complex of schist and granite, to form the gold-bearing deposits. These start from the Yellow Aster and are found at irregular intervals in the contact zone as far east as the Juanita claim. It will be recalled that the early work on the Juanita consisted of prospecting for gold; and that the original discovery of silver ore was made in the district some years later near the south-eastern end of the claim.

The California Rand Mine. The lode on which the Juanita claim was located is at the contact between the schist and the granite of the regional intrusion. This contact strikes south-easterly and dips at a low angle (about 30°) to the north; the side-lines of the Juanita claim are approximately parallel to the strike of the contact. A second intrusion is the silicious dike—called porphyry by some geologists—that strikes approximately at right angles to the schist-granite contact, and which determined the direction of the side-lines of the Uranium claims at the time they were originally located. This dike can be seen outcropping boldly on the hill south-west of the mine. The outcrop appears to mark the foot-wall of the intrusive mass; it can be traced through Uranium No. 1 and Uranium No. 2 to a point about 100 ft. north-west of the company's No. 1 shaft, but it disappears as soon as the granite area is reached, presumably because the intrusion could not penetrate the granite, which is regarded as being older. A 105-ft. shaft, sunk 330 ft. north of No. 1 shaft, and near the north end-line of Uranium No. 2 was in granitic rock for 60 ft., at which depth it entered the schist. A north-west cross-cut in the schist passed through a hard formation that presumably is the east-west dike. If this be the case, the dike is about 60 ft. wide at this point.

One hypothesis for the deposition of the ore is based on the theory that the granite shattered the adjacent schist and formed the north-south fractures that have now become the silver-bearing veins. The subsequent intrusion of the silicious dike re-opened these fractures and probably introduced the silver-bearing solutions. The fissured area near the schist-granite contact was particularly receptive not only because of its physical condition, but perhaps because of its chemical characteristics; that is, the minerals deposited at the time of the intrusion of the granite may later have reacted chemically to stimulate the precipitation of the minerals that formed the rich silver ore. At any rate the silicious dike seems to be the dividing line between the gold and the silver zones of the district, even though it may develop that some other intrusion, which subsequently may be found, brought the enriching solutions.

The point of discovery was 120 ft. east of the foot-wall of the dike, on a line that represents the prolongation of the Juanita contact-vein. The vein itself cannot be traced beyond the dike, although the contact swings and takes an easterly course through Uranium No. 2 and No. 5. No. 1 shaft was started at the discovery-point and followed a wide lode, with a well-defined foot-wall, commonly known as the 'shaft fracture'. A drift on the second level of this fracture has been followed for a total distance of 510 ft., including some work from the 105-ft. shaft mentioned above.

The ore at the surface was oxidized, with flakes and bunches of hornsilver. A peculiarity was the alternation of thin layers of hard and soft material, the soft being far richer than the hard. These layers dipped only from 5° to 15°, to the east, and, as progress was made in sinking, there was constant speculation as to whether each successive lean layer would be underlain by a rich one. The pessimists were sure that the deposit was only a freak, and that after a few lenses near the surface had been mined the bottom would be reached, and it would remain only to follow the layers horizontally to the limits of the orebody. For the first 50 ft. the 'shaft' was a pit approximately 18 by 22 ft. in lateral dimensions, dipping to the east about 78°. As I mentioned in the

FIG. 1. CLAIM-MAP OF THE RANDSBURG DISTRICT

previous article, every pound taken from this pit was shipped as ore. A simple but reasonable explanation of this 'bedded' deposit is that the 'beds' are really flat veins formed by the filling of fractures in the schist, and that the coincidental impregnation of the intervening layers with silver-bearing solution made the lower-grade 'beds'. Or, it may be that some of the layers of schist were more porous or more soluble than others and that the ore-carrying solutions, accordingly, deposited more of their burden in them. The oxidized ore is doubtless enriched by secondary precipitation from descending

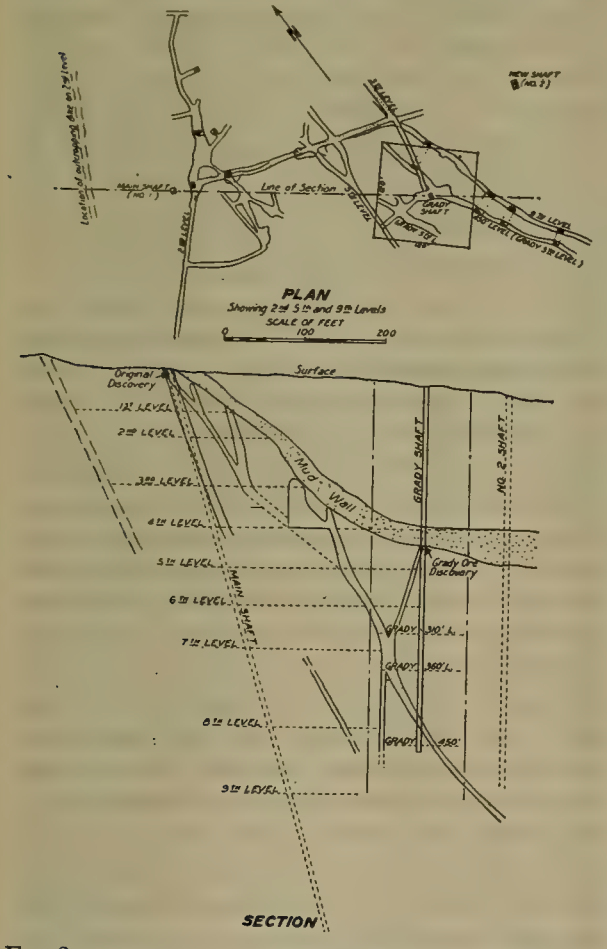


FIG. 2. SHOWING PART OF THE WORKINGS OF THE CALIFORNIA RAND MINE. THE 2ND, 5TH, AND 9TH LEVELS ONLY APPEAR ON THE PLAN.

silver-bearing solutions. Such ore is not found below the 150-ft. level.

The foot-wall of the dike has been reached by crosscuts on the first and third levels as indicated on the accompanying drawing, Fig. 2. This section is taken through the collars of the main No. 1 shaft and the shaft on the Grady lease, so that No. 1 shaft, being off the plane of the section, does not appear to coincide with the dip of the shaft-fracture.

This section also shows the 'mud wall'—the foot-wall of a fault-zone—that has decapitated every branch of the vein except the single outcrop that formed the discovery vein. Had erosion stopped a short time—geologically speaking—before it did, it is probable that even the luck of Williams and Nosser would have failed to find the ore. It is this 'mud wall' that makes it necessary to sink on the Coyote claim and the others lying to the east, in order to prospect. The presumption is that the wall extends indefinitely, though fortunately it appears to flatten, so that the distance necessary to sink in order to pass through it does not increase rapidly.

Fig. 2 also shows the Grady shaft and the boundaries of Grady's block of ground from which he expects to take more than $1,250,000 before his lease expires. It appears that if Grady had selected a spot 20 ft. farther east for his shaft he would have had to sink to about 430 ft. before finding ore instead of cutting it at 200 ft. The chief interest attaching to Grady's mining, however, is the fact that he selected his lease-block in a direction that to everyone else appeared to be entirely off the trend of the ore. A dozen leases were granted in Uranium No. 1, in No. 2, and in No. 4, but no one except Grady considered No. 5 as being worth while. Grady, it appears, was more impressed than others by the fact that rich ore at the point of discovery was near the juncture of the Juanita vein with the north-south dike. He took samples along the surface in the direction of the northerly prolongation of the dike, but failed to find indications of silver, and therefore abandoned the idea of taking a lease in that direction. There remained the possibility that the Juanita vein might have some remote connection with the orebodies. He could not find the contact between the schist and the granite on Uranium No. 5, and accordingly he projected the line of the Juanita vein across Uranium No. 2 and selected the site for his shaft on this projection. In view of the fact that his lease contained an apex clause, it is hard to see why he wanted to be so close to company ground in the direction of the dip of the veins, unless he failed to appreciate the significance of the apex provision. The story of the threatened litigation and the compromise was told in my earlier article.

It should be remembered that at the time the compromise was made, development in the company workings had advanced only to the fourth level; accordingly, no evidence existed to show that the main vein made a junction with Grady's vein. Although the large branches of the main vein dipped easterly, it seemed clear that the Grady discovery-vein dipped in the opposite direction and that a segment of its apex lay within the lease-block, which originally extended 175 ft. farther east than is indicated in the drawing. The latter represents the smaller block as agreed upon at the time the controversy was settled. If the case had been decided on its merits it seems probable that Grady could have established right to the ore in the branch vein between the points where his shaft first cut it, just below the mud wall, and the point of intersection with the main vein. An interesting question would then arise as to what further ore, if any, would rightfully be his. Could he follow the vertical portion of the vein below the junction? or could he prove

that the wider easterly dipping portion of the vein, below the junction, was part of his vein? The answer to these questions would involve a detailed study of the geologic and mineralogic characteristics of the veins and of the ore. Such a study has never been made, but the problem is interesting nevertheless. Still another possibility existed: he might have established the contention that the Juanita contact vein was the true lode and that the north-south veins were branches or spurs from it. If Grady could have done this, the side-lines of Uranium No. 2 and No. 5 would have become end-lines and he could then have mined the ore between the common side-line and his other parallel line. Such a contention, however, would be exceedingly far-fetched in view of the mining done in the workings both of the company and of the lessee. On the 50-ft. level the shaft-fracture, striking N. 30° E., has produced shipping ore for a distance of 220 ft. On the lower levels the shoots of sulphide ore have been developed for more than 200 ft. in a general north-south direction, and the veins have been followed for greater distances, although they do not contain ore throughout their length. The existence of north-south veins of distinct identity must be conceded. Incidentally, I may mention the fact that one of the directors of the Randsburg Silver Mining Co. intimated to me that a contention based on the identification of a main east-west lode might be advanced by his company in an effort to make good its claim to ore that underlies its Coyote claim but that is found in north-south veins that presumably apex in Uranium No. 5. In a recent letter to the stockholders of the California Rand company, Alfred Harrell, the president, says: "The one disquieting feature in connection with our property grows out of activities in the immediate neighborhood of our mine". He urges that "our orebodies must be protected against encroachment".

The Randsburg Silver Mining Co. sank its shaft on the Coyote claim directly in line with the California Rand No. 1 and Grady shafts, or on the projection of the Juanita dike. At 468 ft. a silver-bearing vein was cut, according to reports, but not prospected. At 500 ft. a cross-cut was driven easterly and "278 ft. east of the common side-line [between the California Rand and Randsburg Silver mines] we encountered and are opening up an 8-ft. vein, the direction of its course so far as developed now runs apparently lengthwise through the Coyote and dips toward the east at a pitch of 50° to 60° where encountered, to almost perpendicular in the end of the south drift, now 120 ft. long, on September 17, thus apexing within our claim beyond any question". This is quoted from a circular the purpose of which was to market 50,000 shares of the Randsburg Silver company's stock. However, the company has decided not to ship any ore for the present—whether because it has little to ship, or because it is not sure of the "apexing within our claim without any question" is a puzzle. It is possible that the vein cut in the Coyote, even if it does apex in Uranium No. 5, is not a branch of the main vein but an independent one. In that event it may curve around on its strike so as to leave Uranium No. 5 through its east side-line, in which event the Randsburg Silver company would be entitled to a segment of the vein.

However, the ground intervening between the California Rand workings and the side-line between the Coyote and Uranium No. 5 claims has not yet been explored or developed; when this is done additional light will be thrown on the structural geology, and the questions of apex and ownership of the ore may settle themselves; or it may be that further information will complicate the problems and the outcome will be litigation. A better solution would be a compromise involving the absorption of the Randsburg Silver company by the California Rand company. I do not know that the latter corporation has any desire to acquire the Coyote claim, but if orebodies of any size are developed they could be more advantageously worked by the California Rand than by an independent company.

Development of the Mine. The drawing that shows the section through the shafts indicates the small interval between the levels, the average, down to the seventh, being exactly 50 ft. Two reasons for this are: (1) the fact that development work has never been carried far ahead of mining operations for current production, and (2) the policy of following the ore closely. The high-grade veins split and branch, pinch and widen, both on the strike and on the dip; they are cut by sundry cross-fractures, the intersections usually marking the position of richer ore. For this reason it was desirable to keep close to the ore in order that none might be overlooked, or that time might not be wasted in cross-cutting and drifting in search of the shoots. The running of levels at frequent intervals was pursuant to this policy. The workings on the 90- and 150-ft. levels reached the limits of the shipping ore at points disappointingly near the shaft; accordingly, the development of the third level at 200 was undertaken with some apprehension. The results, however, were reassuring. Ore was taken from long stopes on each of the two vein-systems, one of which strikes nearly north and south, and the other 10° or 15° west of north. On the lower levels connection is made with the Grady workings where the junction of two veins, on both their dip and their strike, has made an ore-shoot 27 ft. wide; and on each of the succeeding levels the development is satisfactory.

In addition to the high-grade shoots that have been partly stoped above the seventh level much low-grade ore has been exposed. The tonnage actually blocked out is not large, but the drifting and stoping to produce ore, together with some work done primarily for development, have shown that 100,000 tons of $20 ore is reasonably assured, above the ninth level.

At points where there is no definite quartz vein of rich ore the schist is frequently streaked with small veinlets of sulphide minerals, caused by deposition in a network of small fractures running in all directions. Much of this material will be mill-ore; the line of demarkation between ore and waste will be determined by

assay. In some parts of the mine a single rich vein is too narrow to stope for shipping ore but can be removed with some adjacent rock and sent to the mill.

CHARACTER OF THE ORE. The ore in the oxidized horizon contains chlorides, oxides, and sulphides in flakes or splotches, together with some bromides and iodides, the gangue being relatively pure quartz. Below the third level, at 150 ft., the ore is exclusively sulphidic, the silver-bearing minerals being argentite, pyrargyrite, proustite, and stephanite. An interesting feature is that, in the richest ore, arsenic rather than antimony seems invariably to be the essential constituent. This might be interpreted as indicating that much of the antimony is in the form of stibnite or other minerals that are not silver-bearing. The gold is believed to be associated with pyrite. In addition to ore in which the silver-bearing minerals in irregular patches seem to be enclosed in the silicified schist with an absence of definite walls, the sulphide horizon also contains well-defined veins composed of compact quartz in which the silver minerals are uniformly disseminated, thereby indicating "concurrent deposition", according to Morris B. Parker, who made a number of geological examinations of the mine for the California Rand company. He considers this to be "primary ore, that has undergone no change since original deposition occurred". On the 250-ft. level, ore of this character assayed from 200 to 300 oz. in a vein 6 to 12 in. wide. This is interpreted by Mr. Parker as proving that the high-grade ore is not confined to a horizon near the surface, where secondary enrichment by re-deposition has concentrated the silver.

MINING. The rapidity with which mining operations were commenced in 1919 was due in part to sundry unusually advantageous conditions. The transmission line of the Southern Sierra Power Co., connecting the generating station at Bishop with the Imperial Valley, passed within less than half a mile of the mine; a pipe-line that was originally laid to supply water to the Osdick mill passed directly through the California Rand property; tracks of the Santa Fe railroad company were only three-quarters of a mile distant; and a good highway was ready for traffic to Randsburg or to the railroad-siding. As soon as the shaft was well started, the partners purchased an electrically-driven hoist, built by the Colorado Iron Works company and equipped with a 50-hp. General Electric motor. A little later two 12 by 10-in. Ingersoll-Rand compressors with appropriate motors were installed and a Champion blower with an eight-inch air-pipe was provided to assist ventilation. Additional equipment has recently been purchased for the compressor plant, as the requirements have increased.

There is nothing novel in the methods of mining. The schist lies nearly horizontal and the ground holds remarkably well without timbers. At the point in the Grady lease where the big orebody has been mined the walls of a huge cavern stand without any supporting timber. Overhand breast-stoping, with a few stulls to provide staging from which to drill, has been used exclusively until recently. J. M. Fox, the new mine superintendent, has started a shrinkage stope above the sixth level. The prime object is to provide a reserve of broken ore from which to draw if all the faces happen to 'pinch' coincidentally.

In anticipation of the completion of the flotation plant, which is now in the course of construction, a new two-compartment vertical shaft was started in April 1921. At the time of writing it has reached the depth of 500 ft. and is being connected with the workings, ready to serve as the main exit for ore about the first of next year, soon after the mill is in operation. The new shaft is north and a little east of the Grady shaft and is just above the site of the mill, which was selected so that the plant would be conveniently situated to receive ore directly from the shaft. The primary crusher is to be fed directly from the mine-ore bin; the broken rock will be carried to the mill structure proper on an inclined belt-conveyor. My concluding article will describe the tests conducted to determine the most advantageous method of treating the ore, and sundry features of the proposed flow-sheet.

(To be Concluded)

WHEN war science learned how to destroy thousands at a stroke, to ruin whole cities in the space of a breath drawn in the middle of the night, peace seemed more and more desirable, says Francis P. Garvan, in an address delivered before the Society of Chemical Industry and the American Chemical Society. "As the researchers in the sciences contributed in ever-increasing frightfulness to the power and long-distance application of war weapons, destroying all the romance of industrial combat and nullifying individual courage, men began to see increasing merit in the dreams of those who would abolish war uutterly and who would police the evil doers of the earth as such are policed in our cities. When the creative chemist showed military commanders how an opposing host could be stricken from life on the wings of the wind, laid horribly in death by a vapor as noiseless at the pinions of Azrael; how life could be expelled from great cities by a death dew of acids sprinkled from airplanes, peace became a boon to be prayed for in utter sincerity. Hypocrisy, smiling at gunpowder, blanched before phosgene gas. I do not say that the spread of education and gradual refinement of the spiritual side of man has not played a part in the growth of the ideal, nor that the operation of pure reason has not contributed to the vitality of the desire. I do maintain, with history at my back, that successive inventions of horribly destructive weapons and successive demonstrations of the magnified and unpreventable ruin and misery wrought by one new weapon after another, have been successive shocks to man's long-time notions about the indispensability of war. There was a time when he said that war could not be prevented. Then he began to say that it was disagreeable on the whole, that it ought to be prevented. Now he is beginning to see that it is so frightful that it must be prevented."

The Lead-Acetate Tartaric-Acid Method of Assaying Cyanide Solutions

By F. Borzynski

The lead-acetate method of assaying solutions for gold and silver is generally used by assayers. With comparatively pure cyanide solutions the method gives good results, but trouble is frequently encountered when the solutions contain impurities or are more than slightly alkaline. The lead sponge obtained under those conditions is often friable and resembles lead powder more than lead sponge. The separation of the powdered sponge from the solution is slow and tiresome work; besides, there is the danger of erroneous results due to the loss of particles of lead. The loss can be averted only with difficulty and not always avoided, unless the sponge is filtered. Those who are at times compelled to filter their sponges know what a mess it makes; they resort to it only in emergencies.

I have performed many experiments in an effort to make the sponge tough and adherent so that there would be no difficulty in collecting and pressing it into a ball suitable for cupellation. While performing those experiments, it was observed that excellent sponges were always obtainable with solutions that were pure and only slightly alkaline. An effort was made to counteract the impurities and neutralize the alkalinity by the addition of various salts and acids. The inorganic salts were harmful or useless. Nitric and hydrochloric acids gave low assay results. Sulphuric acid was beneficial when the right amount was added, but even a slight excess gave an insoluble lead sulphate on addition of lead acetate, whereas not enough produced no improvement in the sponge. Later, acetic, oxalic, and other organic acids were tried. With the exception of tartaric acid all were unsatisfactory, although less so than the stronger inorganic acids.

Tartaric acid gave good results in the preliminary trials. Subsequently experiments were made in which the amounts of tartaric acid, zinc dust, lead acetate, and hydrochloric acid were varied and the quantity of each reagent that gave the best results was determined. Other series of experiments determined the method of procedure. The process thus devised was tested by assaying nearly 400 actual mill-solution samples, all in duplicate—the originals by the tartaric-acid method and the duplicates by the other standard methods. Slightly larger buttons were obtained by the tartaric-acid method. The evaporation in litharge gave the next-best results, but the time and effort required to evaporate, fuse, and cupel was, of course, much greater. In all these experiments, the solutions to be assayed were heated nearly to boiling, but it was proved later that heating was unnecessary. The action is complete at room temperatures, although a little more chemicals and time are required.

The method of procedure that gave the best results is as follows: Prepare the lead-acetate solution by dissolving 300 gm. of the salt in 1000 cc. of water. Always heat this solution to boiling before using it in order that a sponge of uniform size may be obtained. Take 5 to 10 assay-tons of the sample and add ½ gm. zinc-dust. Stir and add ¼ to ½ gm. of solid tartaric acid, or the equivalent amount dissolved in water. As soon as the acid is dissolved, add 10 cc. of the prepared lead-acetate solution and 2½ gm. of zinc-dust. Stir vigorously and add 10 cc. of hydrochloric acid and stir again. The sponge will form rapidly, and the solution being assayed will become perfectly clear in about 10 minutes if cold and one to three minutes if it is heated. Finally add sufficient hydrochloric acid to dissolve the excess zinc. When solutions are not heated, use ½ to 1 gm. tartaric acid and 3 gm. of zinc-dust, instead of 2½ gm. Otherwise the procedure is the same. The lead sponge formed in this manner will be tough and adherent. Any loose particles will readily cling to the bulk when the solution is poured off. The sponge can be washed once or twice by decantation and then dropped into the hollow of the palm and pressed into a ball ready for cupellation. It should be wrapped in a small piece of lead foil, for there is a danger of crumbling it when it is being placed in the cupel with a pair of hot tongs.

The tartaric acid, zinc-dust, lead acetate, and hydrochloric acid must be added in the order given, but the time interval is not important. They can be added one immediately after another or at any time the assayer wishes to do so. The sponge forms so rapidly on addition of acid that a considerable amount of zinc is trapped in it. Part of the sponge projects above the solution and the zinc confined there is inaccessible to the action of the acid. For that reason the hydrochloric acid added to dissolve the excess zinc should be dropped directly onto the sponge.

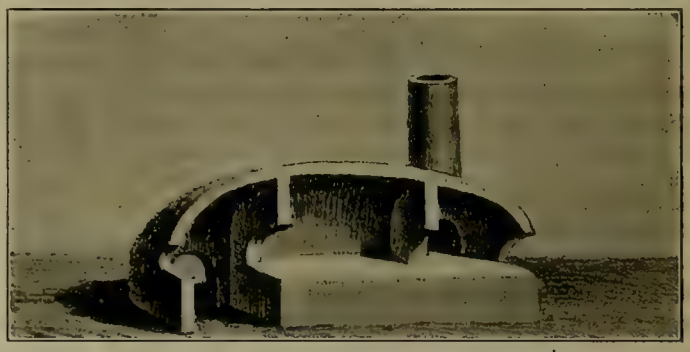
IRON AND STEEL can be successfully made from the 'black' sand of the Pacific coast, according to an article by James L. Avis, Jr., in the 'Western Machinery World'. Virtually all these iron-bearing sands are magnetic and carry a high proportion of titanium, ranging from 8 to 11%. This titanium content tends to cause a clogging of the bosh of the furnaces and has been the cause of the abandonment of most attempts at reducing these sands, for the simple reason that no means for its elimination had been discovered. Obviously the sand must be briquetted and the nature of the binder must be such as to resist disintegration up to the melting point; and the absorption by the slag of the titanium must be accomplished. The New Era Iron & Steel Co. has erected an experimental plant at Sedro Woolley, Washington, where pig-iron is produced at a cost of $24 per ton. The electric smelting of briquettes from these sands is accomplished, converting them into any grade of steel, and particularly the special alloy-steels. As long ago as 1905, experiments were being carried on in different parts of the world, and tool-steel was successfully produced from titaniferous, sulphurous, and other iron ores by electric smelting.

Ancient South American Smelting Practice

*It is common practice in South America to roast the copper ores in reverberatory furnaces. Including the fire-place at one end and the flue at the other, the furnace is about 16 ft. long and 4 ft. broad; the fire-place and roasting-hearth are on the same level, raised 3 ft. above the ground; the fire-place is about 3 ft. long by 4 ft. wide. Three mud arches, with flat tops thrown across, serve instead of fire-bars, the ashes falling down into the pit below and between the chinks in the arches; the fire-place is separated from the furnace by a partition, through which, by means of a low arched communication, the flame is thrown directly on the ore. The heated air and the fume find exit through another arched opening at the opposite end into a chamber, above which there is a columnar chimney about 4 ft. high and of 8-in. internal diameter; through this flue the heated air makes its escape. In the front of the fire-place is an arch opening for the introduction of fuel, which, being resinous (bushes of jarillo), causes a great blaze; it quickly burns to ashes without leaving any permanent cinders. No door is therefore necessary, as the fire requires constant feeding. On the other side of the furnace is an opening onto the hearth, by which the ore is introduced; this opening is closed with a few rough bricks and is plastered with mud.

GRINDING THE ORE. This is accomplished by the same means whether it be previously roasted or not. A rude *trapiche* or mill is constructed. It differs from those used in Chile, already described,† and is built more on the principle of the Spanish flour-mill, except that instead of an upper stone revolving horizontally upon a lower one of equal size, there are two rough and heavy fragments of rock, affixed by hide ropes from each end of a horizontal arm; these are dragged around upon the lower stone. The process therefore is one of grinding rather than of crushing; the moving power is water. Here, as in all the mills of Spanish construction, a small current from a height of about 8 ft. runs in an inclined trough and falls into a series of wooden cups, hollowed out of so many spokes radiating horizontally from a vertical shaft, fixed in a central pivot. The impetus given by this small quantity of water is considerable, and is communicated to the vertical shaft, whose upper end passes through a hole in a horizontal and circular mill-stone, 5 ft. in diameter, and extending a few feet above it. Across the upper part of this shaft a piece of wood is fixed horizontally, forming two opposite spokes, from whose ends the two blocks before mentioned are loosely hung. As the vertical shaft makes about 60 revolutions per minute, the two blocks are therefore dragged around as many times in the same period. A man attends to the feeding of the mill with ore and to the removal, by means of a wooden scoop, of the powder when it is sufficiently ground. The next process is the sifting of the powder through a cylinder, covered with coarse cloth, and having a door in the side to introduce the pulverized ore. The cylinder is enclosed in a wooden case, and is turned by a winch-handle; the finer powder passes through the canvas, and falls to the bottom of the case; the coarser particles are taken out at the door, and are carried back to the mill to be re-ground.

The smelting and refining of copper is conducted by a process certainly neither the most economical nor scientific, as regards the quantity of metal produced; though perhaps the small expense incurred more than counterbalances the loss of copper in such rude metallurgic operations. It does not often happen that reduction can be performed in the immediate vicinity of the mines; more generally the plant is at some distance, where wood and water can be obtained in sufficient abundance; in such a case the ore is brought from the mines on the backs of mules. The first process of reduction is that of roasting, which is conducted in a rude furnace excavated from the foot of the hill. One of the perpendicular walls, part of the side-walls, and the hearth, are formed of the hill itself; the front wall and part of the sides are built of sun-dried bricks, or of stones cemented by mud. Part of the furnace is prepared with a mixture of cement and calcined bones, in order that it may resist the fire; it would otherwise be contracted by the heat, and crack; and through these cracks the metal would escape. The ore and the fuel can thus be thrown easily from the hill into the top of the furnace, which is always left open. A quantity of wood is first added, then a portion of ore, then alternately wood and ore, until the furnace is charged. The ore is carried, in wooden troughs called bateas, to the furnace by peones, the bateas being apportioned to a number of mule-loads of wood, as circumstances may determine. The fuel used is mimosa, or any



FURNACE USED FOR SMELTING COPPER ORE

*Abstracted from 'Travels in Chile and La Plata', by John Miers, published in 1826.

†See 'M. & S. P.' of October 1.

thorny wood that can be procured. The fire is lighted at the bottom, a blast of air is constantly maintained by bellows, which are circular, single valved, in pairs, and in some cases are worked by a water-wheel, from two crank motions; but more often they are worked by hand.

The two bellows are fixed vertically, side by side, upon a wooden base. A tube, generally formed of the osseous stem of the torch thistle or *Cactus peruviana* and covered with mud, proceeds from a central hole in each front fixed board; and these tubes, converging, are inserted into a small hole made for the purpose in the bottom of the furnace. The hind, or movable, bellows-boards being jointed at the bottom to the front boards, a peon stands holding the handle of each in his hands, and, by a violent alternating motion, pushes forward first the one and then the other board, by which action he maintains the continuity of the blast. The fire is kept brisk for about 25 hours; and when the process is considered finished, a tap-hole is opened and there flows out a strange mixture, for the mud lining of the furnace, as well as the adobes, being extremely fusible, are partly melted by the heat, adding to the bulk and to the fluidity of the mass. The fluid mixture flows into a small pit, where it cools, the metallic particles being found in flakes and globules that are interspersed throughout the mass, which is subsequently broken up by a man called a *chanquero*, who, seated on the ground, performs this tedious operation with a hand-hammer.

The slag is first broken into large masses, to separate the flakes and larger lumps of copper, which are placed apart. These are then broken into smaller pieces, which are carefully turned over by the *chanquero*. He, poising them in the hand, can, by practice, ascertain whether to cast them aside for mere slag, whether to break them still further, so as to separate more globules, or to throw them, as they are, among the metallic portions for refining. The hearth of the refining furnace is constructed of solid adobes of sun-dried clay, and is about 15 ft. long, 5 ft. wide, and 3 ft. above the ground. The sides are raised about 2 ft. higher, and the top is arched. There are two chimneys, raised 4 ft. above the hearth, and placed at the corners that are the farthest removed from the fire-place. At each end of the furnace there is an opening; one of these leads into the open air, the other into the fire-place, which is a small chamber built against the end, and is as high as the furnace. Its length is about 8 ft., its breadth about 4 ft., and it is the continuation lengthwise of the whole structure. On the opposite side of this chamber is a large arched opening for the admission of fuel, and on the intermediate side, in line with the two openings of the furnace, is a small aperture, which permits a view of the operations within the furnace at that end.

It is necessary to remove the arched ceiling of the furnace every time the bed is charged. The lumps of metal that collect are thrown in, the ceiling is again closed, and luted with mud. The fire is then lighted, and the furnace is kept at a gentle heat for a day or two, so that it is gradually dried. Finally the fire is raised briskly by throwing into the two large openings of the chamber, faggots or brushwood, or more generally billets of the torch thistle; it is thus maintained for 48 hours in a glowing state. All the doors or vents are kept open during the operation, to watch progress, and to allow a free exit for the flame at all parts, according to the notion of the natives, who believe that they could not produce the requisite heat if any of the openings were closed. It often happens, as might be expected, that cracks occur in the ceiling or dome of the furnace, through which the heated air escapes. On such occasions nothing more is necessary than to patch it with plastic mud, which is always at hand for the purpose. During the process of reduction, the peones stir the fluid mass; and when the reaction is considered complete, a tap-hole is opened on one side of the furnace, where, the bed being low, the metal has collected. The ground around the furnace into which the metal is to be received is prepared by digging out a number of square holes, about 16 in. long, 12 in. wide, and 4 in. deep, which, when smooth, are covered with a coating of wood ashes, to prevent adhesion of the metal to the earth. A number of small channels communicate from one to another; and as the metal runs from the tap-hole, the molds are filled in succession. The thickness of the cakes that are formed varies from 2½ to 4 inches.

THE currencies of Europe are nearing a stage at which it will be impossible to use them as media of exchange. There is no well-defined line at the crossing of which a currency becomes worthless, but evidently it cannot continue to depreciate without reaching, in time, the point where the public will refuse to give anything for it. It is amazing how long a people will makeshift with money that is on the verge of becoming worthless, simply from the force of custom and because they have no substitute, according to the National City Bank. In Russia, the old unit, the ruble, formerly worth about 51c., now has a value so small that the old denominations have long since passed entirely out of use. Even a thousand-ruble note of the new issues will not buy anything. As the depreciation has progressed the denominations have risen, 10,000, 50,000, and 100,000-ruble notes becoming the common change in use. The Polish mark, nominally worth 23.8c. in money of the United States, is quoted at 0.03c.; the Austrian crown, formerly 20c., is only slightly higher; the crown of Jugo-Slavia, which corresponds to the Austrian unit, is worth a little more, about 0.36 of a cent; the crown of Hungary is worth about 0.1 of a cent. These currencies are near extinction, and live on only because there is nothing to take their places. It is difficult to see how business can be carried on with them, and particularly how any agreement for future performance can be entered into in terms of them. Even small fluctuations in the value of these infinitesimal units would have great effect in the value of commodities. How can any credit be given in terms of money? All past indebtedness is practically wiped out, and while that for the moment may benefit debtors as much as it injures creditors, how dare anyone take a creditors position for the future?

H. W. MORSE WILL ADDRESS SAN FRANCISCO SECTION OF THE INSTITUTE

The December meeting of the local section of the A. I. M. & M. E. will be held at the Engineers' Club on Tuesday evening, December 20. H. W. Morse will read a paper entitled 'Present Status of the Treatment of Mixed Copper Ores'. The meeting will be preceded by the usual dinner at 6 p.m.

COPPER AND BRASS RESEARCH ASSOCIATION MEETS IN NEW YORK

The first annual meeting of the Copper and Brass Research Association was held on December 6, at the offices of the Association at 25 Broadway, New York. The following directors were elected to serve for the ensuing year:

R. L. Agassiz, Calumet & Hecla Mining Co.; J. W. Allen, Greene-Cananea and Inspiration; H. F. Bassett, Taunton-New Bedford Copper Co.; H. C. Bellinger, Chile Exploration Co.; Edward H. Binns, C. G. Hussey & Co.; Stephen Birch, Kennecott and Braden Copper companies; F. H. Brownell, American Smelting & Refining Co.; J. Parke Channing, Miami Copper Co.; F. S. Chase, the Chase companies; Carl F. Dietz, Bridgeport Brass Co.; Walter Douglas, Phelps Dodge Corporation; B. Goldsmith, National Brass & Copper Co.; E. O. Goss, Scoville Mfg. Co.; Robert H. Gross, East Butte Copper Mining Co.; Charles Hayden, Chino Copper Co.; U. T. Hungerford, U. T. Hungerford Brass & Copper Co.; C. V. Jenkins, Chino Copper Co., C. F. Kelley, Anaconda Copper Mining Co.; H. B. Paull, Calumet & Arizona Mining Co.; R. M. Raymond, United Verde Extension Mining Co.; H. J. Rowland, Rome Brass & Copper Co.; A. B. Seelig, Michigan Copper & Brass Co.; W. Parsons Todd, Copper Range company.

The directors elected the following officers for the year 1922: president, R. L. Agassiz; vice-presidents, C. F. Kelley and F. S. Chase; treasurer, Stephen Birch; secretary, W. S. Eckert; manager, William A. Willis.

RICH ORE DISCOVERED NEAR IDAHO SPRINGS, COLORADO

A dispatch from Idaho Springs says that the richest gold discovery in Clear Creek county, Colorado, for years has been made on unpatented property, the Queen Elizabeth claim of the Frank J. Hayes Mining Co., in Virginia canyon. This company has been driving an adit, now in 225 ft. Recently a winze was started about 175 ft. from the portal. The first round of holes disclosed 10 in. of ore that assayed 8.50 oz. gold and 17.60 oz. silver. With the winze at 10 ft. the streak has widened to 18 in. and a sample taken over its entire width gave 68.90 oz. gold and 11.85 oz. silver per ton. The ore is now being sacked. The property lies on the opposite side of the canyon to the Treasure Vault mine with a record for past production of high-grade ores. James R. Noland is vice-president of the company.

IRON CAP V. ARIZONA COMMERCIAL—SUIT STARTS AT GLOBE

In the Superior Court of Gila county, Arizona, the hearing of the apex suit of the Iron Cap Copper Co. against the Arizona Commercial Mining Co. to decide the questions of extra-lateral rights to sundry orebodies, started on December 12. Presiding will be Judge Samuel Battee of Tucson, Judge G. W. Shute of the Gila County Court having expressed a sense of disqualification. Horace V. Winchell, who has appeared as an expert witness in several important apex cases, will appear for the plaintiff, as well as R. H. Hunt and W. H. Wiley of Los Angeles. For the Arizona Commercial, expert testimony will be given by Albert Burch and G. M. Bjorge, the latter for several years geologist for the Old Dominion and Arizona Commercial companies. Edward T. McClennan of Boston is chief counsel for the Arizona Commercial, and Morris & Mallot appear for the Iron Cap.

TONOPAH WILL PRODUCE $650,000 IN DECEMBER

At the present rate of production the value of silver bullion shipped from Tonopah during the month of December will run over $650,000. Reports of clean-ups for the last half of November shipped the first week of December indicated a steady increase in the tonnage and value of ore. The MacNamara, the smallest mill, chiefly concerned with treating custom ore, announced that beginning this month the company will resume shipments of bullion every 10 days instead of waiting for the usual 15-day period. This indicates an increase of 30% in the output of bullion. The Tonopah Belmont company shipped 68 bars weighing 129,877 oz., valued at $149,000; the West End sent out 25 bars weighing 49,800 oz., valued at $55,000; Tonopah Extension shipped 24 bars weighing 43,000 oz., valued approximately at $48,500; the MacNamara shipped 7 bars worth $14,000; and the Tonopah Mining Co. shipped 23 bars for which the company furnished no estimate of weight or values.

UTAH COPPER DECLARES DIVIDEND OF 50c. PER SHARE

At a meeting of the directors of the Utah Copper Co. in New York City on December 7, a dividend of 50c. per share was declared, payable December 31. During the present year, Utah Copper has paid its stockholders $2.50 per share in dividends, or a total of $4,061,225. The grand total of dividend disbursements to the close of 1921 will be $115,570,887. The company recently put a steam-shovel to work at Bingham, for the purpose of loading several thousand tons of ore. When operations were suspended last April the company was making metallurgical tests at the Arthur plant on a practical scale, and it has been decided to complete these experiments during the present winter.

NEW STACK AT U. S. SMELTER AT MIDVALE, UTAH, COMPLETED

The new smoke-stack at the Midvale plant of the United States Smelting Co. has been completed in record time, less than four months being required for its construction. Flue-connections from the furnaces to the stack have also been completed, and gases are now being discharged at a point 178 ft. higher than was possible with the old steel stack. All of the material for the stack was procured within a

radius of ten miles of Salt Lake City. The steel was furnished by the Utah Steel Corporation; the radial brick and Weiderholdt tile were made by the Utah Fire Clay Co. The foundation of the stack is of reinforced concrete, octagonal in shape; it is 87 ft. in diam. and 10 ft. thick. The lower 5 ft. is a solid block, and the upper 5 ft. is stepped, making the top 51 ft. across. The stack is 451 ft. 4 in. high. The outside diameter at the base is 46 ft. 1 in.; the inside, 39 ft. 5 in. At the top, the outside diameter is 29 ft. and the inside 24 ft. The coping on the top is 30 in. wide. For the first 125 ft. the outer shell is made of radial brick, filled with reinforced concrete. There is a 3-in. air-space left, and then a lining of 4½-in. soft glazed brick, hard-fired, and built for insulation. Eight lightning rods, tipped with platinum, have been installed. The rods are connected with ⅝-in. copper cables that are carried to a depth of 14 inches in the ground. Provision has been made for taking samples of smoke from various points in the stack. There was used in the construction of the stack 15 cars of cement, and in the foundation, 12 cars, or a total of 981 tons. Thirty-three cars of sand was used in the stack construction and 21 in the foundation, or 2349 tons. Forty cars of gravel, or 2295 tons, was used in the foundation. Two carloads of Utah Copper tailing was used in the brick-mortar lining, making it acid-proof. Sixty-five cars of brick and tile was used, or 2174 tons. The material used in the entire structure totaled 189 carloads, or 8451 tons. Since the beginning of the work, the ground has settled but 1¼ in., but this is evenly distributed. The Weiderholdt Co. of St. Louis had the contract for the work. A crew of 31 men was employed, under J. D. Martin, superintendent. It is stated that the cost was about $150,000.

VALUATION ENGINEERS TO BE APPOINTED BY TREASURY DEPARTMENT

The Internal Revenue Bureau contemplates the appointment of 75 valuation engineers, of whom 45 will be detailed to the natural resources subdivision, 30 on valuation of oil and gas, and 10 on coal, timber, and metals. Answering complaints that the tax law and forms are complex, Internal Revenue Commissioner Blair says they will continue so as long as business is complex.

ENCOURAGING OUTLOOK FOR ZINC MINES IN WISCONSIN

Offerings on zinc ore increased substantially in the Wisconsin zinc district during November, the base price for 60% blende going to $29 per ton; sales were made which brought the price on premium grade to a point close to $31. Compared with the quotations obtaining in the Mo-Kans-Okla districts Wisconsin prices were far ahead, the difference in price arising from the advantage enjoyed by Wisconsin producers in nearness to the zinc smelters of the Illinois coalfield and the lower freight-rates. Developments during the month are significant. The Illinois Zinc Co., down for the better part of the current calendar year, has heated up its big works ready for operation. This means that this concern will be in the field for high-grade blende. The Matthiesen & Hegeler Zinc Co. of LaSalle, Illinois, bought the entire manufacturing plant of the Smeeton Shingle Co. and its rights, and began the manufacture of Smeeton zinc shingles, in three sizes. This will mean an increased market for zinc ore.

Lead ore experienced a decline in price but not sufficient to deter prospect work and selective mining. The base price dropped from $55 to $52.50 per ton, base 80% metallic content. Production was increased and shipments were made. Heavy rains over the latter part of the month retarded operations at mines, especially in districts somewhat removed from the railways, and dependent on dirt roads for haulage. Several mining companies gave attention to road construction and ballasting with tailing. Outlying producers find road building to be a good investment.

FREIGHT-RATE HEARINGS

From December 14 to 21 the Interstate Commerce Commission will hear the railroads in its investigation of the rate situation; it announces a schedule for hearings arranged according to commodities after cross-examination of the railroads beginning January 9. The Commission will seek to determine whether present rates are reasonable in the aggregate in the country as a whole or in the rate groups, and whether rates on specified commodities or descriptions of traffic are reasonable. It will also determine the rate of return to which railroads may be entitled after March 1 when the present 5½% guarantee expires. Special consideration will be given to coal transportation. In its investigation of the railroad situation the Senate Interstate Commerce Committee heard Frank J. Warne on behalf of railroad workers who criticized financial holdings of railroad officials in companiees from whom purchases of coal, steel, oil, and other supplies are made, alleging that it resulted in high prices and high freight-rates.

ONE-THIRD OF OUR COPPER EXPORTS GO TO GERMANY

More than one-third of the copper exported from the United States in the first ten months of this year was consigned to Germany, as 185,000,000 lb. of the 494,000,000 lb. shipped abroad, went to that country. By including the clearances to Holland, intended largely for German consumption, shipments to Middle European countries went above 200,000,000 lb. The combined takings of France and Great Britain did not equal the shipments to Germany. Although it has figured in copper market gossip as a heavy buyer of the metal, Japan's takings, as measured by exports to that country, were not much more than half last year's total, the exports up to November 1 amounting to 42,000,000 lb., against 82,000,000 lb. in the first ten months of 1920. Copper sales in the month just closed were the largest of any month this year. Between 160,000,000 and 170,000,000 lb. of metal was contracted for by both foreign and domestic buyers. A large proportion of this is for domestic delivery.

Several of the largest producers of copper, having sold all they care to at current prices, have withdrawn from the market and are holding their metal for 15c. per pound. This is true of the United Metals Selling Co., which has remained aloof from the market for some time, waiting for higher prices.

INTERPRETATION OF THE RECENT WAR MINERALS RELIEF ACT

Promulgation of official interpretation of the broadened provisions of the War Minerals Relief Act will soon be made by Secretary of the Interior Fall. It is estimated that 670 cases are affected. Tentative plans under which the Commission expects to take up re-opened cases calls for the distribution of a revised questionnaire which claimants will be asked to submit along with additional evidence to support claims for further consideration. It is expected that practically all the 610 cases which the Commission has previously rejected under the request or demand decision will be reconsidered. There will probably be 50 cases to be considered which involve the question of time of submitting the claim, the new law reversing the decision made by the Comptroller of the Treasury by recognizing claims which actually started on their way to the Commission within three months after the passage of the original bill, without requiring that they be in the hands of the Commission within that time. At

least three additional claims will come up for reconsideration on the grounds that errors were made in awards which have already been granted, and it is likely that several other cases involving the question of commercial value and the charging of loss directly to government stimulation will come up. The vast majority of cases which have been rendered eligible for additional consideration by the new law have never been subjects of initial investigation of auditors or field-engineers. Field-work will hardly be possible on a large scale until spring. The time which has elapsed since these claims were last brought before the Commission is also expected to place a handicap upon field investigations.

COAL MINING INSTITUTE MEETS AT PITTSBURGH

The 35th annual meeting of the Coal Mining Institute of America was held at Pittsburgh, Pennsylvania, on December 7, 8, and 9. Papers read included the following: 'The Mineral Resources of Pennsylvania', by George H. Ashley, State Geologist; 'Safety Gates and Safety Appliances for Cages and Hoisting Shafts', by William G. Duncan, Director of Mining Extension Work, State College, Pennsylvania; 'Explosion-Proof Mine Locomotives', by L. C. Ilisley, electrical engineer, U. S. Bureau of Mines; and 'Comparative Haulage Costs—Animal and Mechanical', by A. F. Strouse. There were ten discussions at the Question Box Sessions on various phases of coal mining. At the annual dinner there was a large attendance. H. Foster Bain and George Otis Smith, directors, respectively, of the U. S. Bureau of Mines and Geological Survey, were speakers. Inspection trips included a visit to the 5000-ft. Liberty vehicular tunnel being driven on the south side of Pittsburgh, also to the Bureau of Mines Experiment Station and the mining department of the Carnegie Institution of Technology. H. D. Mason, of the Mine Safety Appliance Co., Pittsburgh, Pennsylvania, is secretary of the C. M. I. A.

ARIZONA

Clifton.—The new organization of the Clifton-Morenci Branch of the Phelps Dodge Corporation has been announced by Walter Douglas, president. The manager is J. P. Hodgson, former superintendent of the Copper Queen mines at Bisbee and later in charge of the Detroit mines and works, operated as the Phelps Dodge Morenci Branch. For assistant he will have William Savin, who comes from the Copper Queen at Bisbee. Norman Carmichael will become consulting engineer for the Phelps Dodge Corporation, with offices at New York. He has been with the Arizona Copper Co. since 1905, and for years has been manager of this British company, which lately transferred its Arizona interests. Announcement is made that no large plans of rehabilitation or change will be put into execution now, but work on remodeling of the Arizona Copper concentrator No. 6 will be started at once on plans already made.

Interior of Inspiration Mill at Miami, Arizona

Globe.—The Superior & Boston company, after six months of inactivity, has resumed mining and will send copper ore to the Miami plant of the International Smelting Co. This announcement has been made by E. G. Deane, superintendent. An agreement has been made with the smelting company to treat copper ores carrying silver. Much ore already is available in the mine-bins, averaging about 8% copper and 30 oz. silver. It has been held because no copper smelting was being done at El Paso. Three cars of silver ore sent to El Paso netted the company about $18,000. The silver ore has persisted to an unlooked-for depth, and silver and copper alike are found on the 400- and 600-ft. levels of the Footwall vein. A cross-cut has been started on the 200-ft. level to connect the McGraw shaft with that on the Eclipse claim, a distance of 900 ft., in virgin ground.

Jerome.—Directors of the Dundee-Arizona Copper Co. have just visited the property and it is reported that it is the

intention of the company to start operations the first of the year. The mine is at present flooded. Some promising veins were opened prior to pulling the pumps; and it is upon these that it is proposed to sink a 500-ft. winze. The company recently secured a permit from the Corporation Commission to sell 61,120 shares of stock.

Kingman.—The Tom Reed Gold Mining Co. has announced its intention to accept custom gold ores and operate its mill as a custom plant. A test-run is now being made at the mill to get data on the cost of treating ore of variable grade. There is a considerable tonnage of payable gold ore developed in the smaller mines in the Oatman district which can now be mined. The operation of the Tom Reed mill as a custom plant will no doubt be an incentive to more active prospecting.

Development on the 100-ft. level of the Gold Chain mine has opened high-grade silver ore 140 ft. east of the shaft. The ore, which is oxidized, was opened after passing a fault. A cross-cut is being run. Development to date has opened 40 to 50 ft. of fair gold ore on the 100-ft. level which is 200 ft. below the outcrop.

Messrs. Good and Hodge, who have a lease and bond on the Enigma claim in the Weaver district, have opened ore running 1800 oz. in silver and $200 in gold per ton at the bottom of an old 40-ft. shaft. The shaft has been sunk several feet into the ore and shows the vein carrying the high-grade to be eight inches wide. The Enigma once produced some bonanza ore.

The 70-ton mill of the Kaaba Mining Co., 30 miles east of Kingman, is being made ready for operations. The Kaaba mine is said to have 30,000 tons of vanadium ore blocked out; it averages 1½% vanadium oxide.

Machinery at the White Hills Mining Co.'s mines is being installed rapidly. The many lessees on the property are opening a greater tonnage of ore than was anticipated. At present the company is carrying on sinking at the G. A. R. and Occident mines. A new orebody of rich silver ore has been opened on the 200-ft. level of the G. A. R. mine. The ore-streak is said to be five inches wide and has been drifted upon for 30 ft. There are at present 30 men working at the property.

Phoenix.—No defence has been offered by the Arizona Hercules Copper Co. to a foreclosure suit brought against it here by the Empire Trust Co. of New York, trustee, and default judgment will be entered soon by the plaintiff's attorney, Richard E. Sloan. The principal sum is $3,000,000, with $577,000 added interest unpaid; 90% of the defendant corporation's stock has been held by the Ray Hercules Copper Co., which has been operating mines on Mineral creek, Pinal county, east of the main workings of the Ray Consolidated, its claims covering about 200 acres. The debt was incurred through construction of a modern flotation-mill, with Diesel power-plant, an efficient hoist, concrete ore-bins, shops, railroad connections, a bridge across Mineral creek, and other improvements through which there was to be handled at least 600 tons of ore per day. The mill ran only a few weeks. There is said to be developed an orebody estimated at 25,000,000 tons above the 500-ft. level, with 10,000,000 tons claimed to exceed 2% copper. There had been dissention within the company and some litigation with the Ray Consolidated. For more than a year the mine and works have been inactive. The stock has fallen from about $5 per share to a late quotation of 25 cents.

CALIFORNIA

Grass Valley.—H. J. Snyder and associates, of San Francisco, are re-opening the Good Hope mine situated in the Spenceville district. A 100-ft. shaft, sunk many years ago, revealed a well-defined vein.

Jackson.—It is reported that excellent ore has been found in the course of development at the old Moore mine.

Susanville.—A cyanide plant is to be erected at the Osterbloom mine situated in the Milford district. A. J. Osterbloom, the owner, reports that a large body of medium-grade ore has been opened.

Westpoint.—The Westpoint Gold Mines Co., controlled by the North Star Mines Co. of Grass Valley, has taken an option to purchase the Combination group of claims. According to A. B. Foote, superintendent for the North Star company, the erection of a 60-stamp mill is being considered. The group includes the Lone Star mine and the Keltz mine, as well as a number of smaller properties. A number of shafts and extensive drifts have exposed ore in the different mines, although the record of production in past operations is not stated.

COLORADO

Boulder.—The Potosi-Caribou Mining Co. has completed arrangements to operate the Boulder County milling plant, providing transportation for ores can be secured. Motor-trucks will probably haul the ore by contract. The Potosi mine has a large tonnage of mill-ore available. The company is financed by New York and New Jersey capital.

Breckenridge.—The leasing company headed by George Robinson and W. T. Keough of Summit county, operating the Warrior's Mark, has opened high-grade ore assaying as high as $1000 per ton at a depth of 100 ft. from the surface. The pay-streak is 10 in. wide and native silver is found in the vein. A consignment is being prepared for shipment to the Arkansas Valley smelter at Leadville before the first of the year. The Warrior's Mark is situated about one mile from the Belmont switch near Boreas Pass, and the road will be kept open during the winter.

Central City.—Returns from a shipment from the Frontenac to the A. V. smelter at Leadville showed 1.82 oz. gold and 12.5 oz. silver; net return, $641.62 for a 20-ton lot.

Colorado Springs.—Directors of the Cresson Consolidated Gold Mining & Milling Co. on Tuesday, December 6, declared a quarterly dividend of 5c. and an extra dividend of a like amount, making the distribution $122,000 or at the rate of 10c. per share on stock issued. The dividend is payable January 10, 1922, to stock of record as of December 31, 1921. With this payment stockholders will have received $8,979,102 in dividends. The property of the company, the Cresson mine on Raven hill at Cripple Creek, continues to produce heavily.

Cripple Creek.—Production of the gold mines of the district for November, while showing decrease of 1740 tons as compared with the October figures, had an increased value of $9218 due to a better grade of ore treated at the Golden Cycle mill. The figures reported by the mills are: Golden Cycle, 21,000 tons, $15.50 average, value $315,000; Portland company's Independence mill, 23,200 tons, $4.30, value $99,700; Lincoln M. & R. Co.'s Ironclad mill, 400 tons, $1.50, value $600.

The Golden Cycle M. & R. Co. paid its stockholders a 2c. dividend amounting to $30,000 on December 10, bringing the total dividends to date to $9,633,500. As shown by the monthly report the Cycle mill is treating all ores shipped from the district, and in November received 540 cars broad-gauge.

Work has been resumed on the Hoosier mine, at Hoosier Pass, between Tenderfoot and Globe Hills, by the Grafton Gold Mining Co., the original owning corporation, incorporated in 1896. Diamond-drill contractors have been engaged and are now drilling in search of new ore-shoots.

Ouray.—The Chipeta M. M. & S. Co. has completed the installation of machinery and is now using air-drills in development. Work is to be continued during the winter in the H. A. C. mine, where surface showings are encouraging.

——The Revenue is preparing to resume and the Terrible vein will be more fully developed. A new company organ-

ized by Bradish P. Morse will operate the property.——A compressor has been installed on the Barstow mine and lessees are operating.

Telluride.—The Smuggler Union mill shipped 60 cars of concentrate to the smelter and the Tomboy mill 45 cars during the month of November.

IDAHO

Kellogg.—The Bunker Hill smelter is now operating two furnaces and is treating about 600 tons of ore per day. The second furnace was blown-in the latter part of November. It was made necessary by the large accumulation of ore at the smelter. Through concessions in freight-rates the Kellogg plant is now in position to secure shipments from western Montana, northern Idaho, eastern Washington, and British Columbia, sections which in the aggregate produce considerable tonnage and which have a promising future in respect to steady increase in mineral production. The Bunker Hill plant has four furnaces and is therefore in position to meet all requirements of the field it serves.

Leadore.—The E. H. and W. C. Dewey Investment Co., of Nampa, has taken a bond and lease on the Kimmel mine and adjacent claims. The company will start active development at once.

Mountain Home.—The Federal Power Commission has granted a preliminary permit to the Elmore Copper Co. The company proposes to build a dam on the south fork of the Boise river 25 miles above Arrowrock dam, where it is expected 3000 hp. can be developed which will be used at the company's mine and for general purposes. The company will examine foundations for the dam and is given two years to study the available flow of water in Boise river.

MICHIGAN

Houghton.—Predictions that November, the last full month of the season of navigation, would be the banner month for copper shipments out of the Lake district, are borne out by the official records. The total, 22,532,000 lb., is more than double the amount shipped out in October when 10,840,000 lb. went forward and compares with 7,028,000 lb. for September. It also surpasses the total for November 1920 of 16,690,000 lb. Calumet & Hecla's shipments by boat from its smelter docks at Hubbell totaled 9,070,000 lb., while 904,000 lb. was shipped from the Dollar Bay docks, where Osceola and Isle Royale copper is stored. From the Michigan smelter, which treats Copper Range, Mohawk, and Wolverine mineral, 8,828,000 lb. was shipped. Quincy sent out 3,730,000 pounds.

So far as this district is concerned the metal situation gives rise to optimism, for it means that the mines now closed must give attention soon after the first of the year to plans for resumption. While operations may not actually start until spring, considerable work will have to be done in the way of preparation.

Calumet & Hecla is confronted with problems of deep mining but it is solving them satisfactorily. Never in the history of the company has the routine of Calumet & Hecla's operations been better organized than at present and in a reorganization of working forces, such as will be necessary when operations are resumed, considerable economy will be effected. The abnormal labor costs of the war years of course will be dispensed with and in addition each department will be conducted in strict accordance with its actual necessities. In the matter of power alone, a big saving will result from the extension of the company's power lines from its plant at Lake Linden to the subsidiary mines north of Calumet. These mines, with the exception of Ahmeek, purchased power heretofore from a private company. In so far as possible steam equipment will give way to power-driven machinery, including electric pumps and underground electric haulage. In Calumet & Hecla proper, once operations are resumed, the haulage drift at the 81st level of the conglomerate shafts will be pushed through to completion as rapidly as possible, making possible eventually a reduction of costs in the mining of conglomerate ore at depth.

MONTANA

Elkhorn.—The East Butte Copper Mining Co. is operating its 150-ton cyanide plant. The vein is said to be 30 ft. wide; the ore averages about $8 per ton in gold.

Helena.—The Carbon Hill mine, in the Grass Valley district, has a carload of ore that will run $50 per ton in silver.——Silver-bearing ore is being shipped from the Franklin mine dump to the East Helena smelter.

NEVADA

Elko.—The Catlin Shale-Oil Products Co. has purchased the experimental plant formerly operated by the Southern

Pacific Co. The equipment will be added to the enlarged plant being constructed by the Catlin company, which is engaged in producing gasoline, distillate, lubricants, and paraffine wax from shale. Development of the shale deposits near Elko is being hastened; a large tonnage of shale is reported to be exposed.

Pioche.—Ore shipments for the week ended December 9 were as follows: Black Metals Mining Co., 215 tons; Bristol Silver Mines, 320; Pioche Assay Office, Mascot lease, lot No. 1, 40. Leasing operations are increasing in the district. At the present time there are more active operating properties than for a number of years past. These operations, though small, should do much toward the future development of the entire district.

Tonopah.—The Tonopah Extension Mining Co., which recently acquired the Cash Boy mine as a result of a compro-

mise of an apex dispute, is preparing to develop the property at greater depth. Connection will be made from the lower workings of the Extension mine.

The shaft of the Tonopah Divide mine has reached the 1200-ft. point and the work of cutting a station is well under way. While it is being prepared a cross-cut will be driven south-west, toward the main vein, for a sufficient length to provide space for handling timbers and storing tools and supplies while further sinking is in progress. The company has purchased from the Jumbo Extension Mining Co. the 100-hp. electric double-drum hoisting-engine formerly in use at the Velvet shaft of the latter company. One of the raises from the eighth level, near the south-east boundary of the property, will connect with the drift on the fifth level at a point where that level was connected with the Gold Zone workings. This will provide good ventilation throughout all workings to the eighth level. Shipments of ore to the Belmont mill at Tonopah continue at the rate of 50 tons daily.

The county commissioners of Nye county are taking steps to place the roads communicating with the principal outlying camps in first-class shape. The first project was an entirely new road to Royston to take it out of Esmeralda county. The route takes a high line winding around the hilltops and using part of the old Liberty road. This will shorten the distance between Tonopah and Royston four miles. Orders were given recently for a road gang with two motor-trucks to be placed on the road leading to Groom on the border of Lincoln county. The old route over the Bellehelen summit will be restored and by the building of a cut-off it is claimed that the distance to Eden Creek and Reveille will be shortened 16 miles.

UTAH

Alta.—A new orebody has been opened in the Emma Silver mine, according to M. M. Johnson, consulting engineer. A short time ago, a drift was started south, along the Montezuma fault. Four inches of high-grade silver-lead sulphide was found; and this ore has opened to a width of four feet.——About four feet of snow has fallen so far this winter in Alta.

Bingham.—The Montana-Bingham Mining Co. is now shipping more than 100 tons of ore per day to the Garfield smelter. This ore is low in copper and high in iron, and makes an excellent fluxing material. The company employs 70 men.

Eureka.—The Grand Central Mining Co. will pay a dividend of 1½c. per share on December 20. This is dividend No. 75, and will total $9000. On January 10 of this year the company paid a dividend of one cent per share.

During the week ending December 3, the output of ore totaled 166 cars, of which 38 cars were shipped to the Tintic Milling Co.'s plant. The Tintic Standard shipped 52 cars; Chief Consolidated, 42; Victoria, 17; Dragon, 14; Eagle & Blue Bell, 10; Iron Blossom, 8; Colorado, 4; Empire Mines, 4; Centennial-Eureka, 3; Swansea, 3; Gemini, 3; Alaska, 2; Bullion-Beck, 1; Gold Chain, 1; Sunbeam, 1. Output the previous week totaled 170 carloads.

Park City.—Directors of the Park-Utah Mining Co. declared an initial dividend of 5c. per share on December 5. This called for the distribution of $50,000, and payment was made on December 15 to stockholders of record December 10. The Park-Utah is one of the most successful mines developed in Utah in recent years; it is controlled by the Judge interests. The company was incorporated in 1917, but development was not undertaken in earnest until 1919, owing to war conditions. Work was started from a point about 10,000 ft. in from the portal of the old Ontario Drain Tunnel. The main adit in the property is the 1500-ft. level. The company is shipping about 2000 tons of ore per month, all of which comes from development work. It is stated that the net smelter returns indicate an average value of between $45 and $50 per ton. George D. Blood, formerly mine manager of the Silver King Coalition mine, is general manager for the Park-Utah.

Ore shipments for the week ending December 3 totaled 2069 tons, as compared with 2110 tons for the preceding week. The Judge allied companies shipped 967 tons; Silver King Coalition, 709; Ontario, 393.

Richfield.—It is reported that the Mineral Products Co., which is said to be controlled by the Armour interests of Chicago, will install an improved reduction plant within 90 days, to treat the immense alunite deposits owned by the company in Piute and Sevier counties. The company suspended operations about a year ago, giving as a reason the low price of potash. It is stated that a chemist named Hansen has perfected a process for the reduction of alunite that will permit of a comfortable margin of profit at the present quotations for potash.

Salt Lake City.—A second hearing was held before Judge Tillman D. Johnson on December 11, in the case of the Utah-Apex Mining Co. v. the Utah Consolidated Mining Co., due to failure of the two companies to agree upon the value of the ore taken from the Utah-Apex mine at Bingham by the Utah Consolidated. The first statement filed by the Utah Apex gave the value of the ore unlawfully extracted as being "in excess of $1,000,000", whereas the Utah Consolidated placed the figure at about $500,000. Judge Johnson ordered both companies to prepare new estimates. The revised figures filed by the Utah-Apex total $1,171,679.26, while those submitted by the Utah Consolidated are approximately $1,070,000, a difference of about $100,000.

WASHINGTON

Seattle.—The 26th Annual Winter Session of the College of Mines, University of Washington, will be held during the 12 weeks from January 5 to March 22. This session is open to any interested man who can read and write English. The expenses will be limited to a tuition fee of $15, laboratory deposits to cover materials actually used, and the cost of the necessary text-books. The training consists of lectures with laboratory practice, for which the laboratories of the College of Mines are thoroughly equipped.

WISCONSIN

Benton.—A new mining company, recently organized, made up of Platteville mining men, is engaged in shaft-sinking on the Calvert land, where lead is making in all three openings. The property will be fully equipped this coming spring.——The McGuire-Stephens mine is equipped for output; carbonate zinc ore at 55 ft. from the surface is opened.

Cuba City.—The National Zinc Ore Separators was supplied with zinc concentrate for November from the Dale, Connecting Link, and North Unity mines. Some high-grade blende was sold in the early part of the month to American Metal Co. Shipments of sulphuric acid, however, have been in fair volume and regular.——The Connecting Link Mining Co. which adhered to regular working schedules through the entire period of depression, used three motor-trucks to haul to the National Separators plant.——The Big Dick mine, owned and operated by the Zinc Hill Mining Co., has been unwatered and is in shape to begin operations.

Livingston.—The Vinegar Hill Zinc Co. is operating steadily and large quantities of zinc concentrate are being shipped to the National Zinc Separators plant at Cuba City.

Mineral Point.—Shipments of oxide zinc from the works of the Mineral Point Zinc Co. continue fair. Both blocks of furnaces are in operation, each block containing 12 double-compartment furnaces.

Platteville.—H. E. Stephens, one of the owners of the

Block-House group of zinc-producers has been active in organizing a company for the purpose of exploring veins crossing the city. Impetus has been given to mining in this locality by the opening of the famous Empire-Enterprise 'range'. It is held by expert field men that this was not the only range in this district, and finds made in sinking wells and in trench-diggings encourage the belief that ore will be found west and south-west of the city.

In the suit of Thomas Dawson v. the Wisconsin Zinc Co., in claim for damages to land and crops from fumes escaping from a zinc-separating plant, operated by the latter at New Diggings, a jury in the circuit court awarded the plaintiff a judgment for $900. Action was started with claim for damages set at $1800.

BRITISH COLUMBIA

Ainsworth.—Dan McGillis and Al Morrison have uncovered a 1-ft. vein in a tunnel at the Tam O'Shanter group, in the Riondell district. The ore shows free gold; it is estimated to run about $100 per ton. Last year 56 tons of ore was shipped to Trail from surface workings. The shipment of ore from the Florence mine to the Bunker Hill & Sullivan smelter gave a return of 69.8% lead and 15 oz. silver per ton. Now that a market has been assured for the output, the Florence Silver Mining Co. purposes to increase its milling output. A large body of ore has been developed, the ore occurring in both fissure and replacement veins.

Revelstoke.—While on fire-patrol duty near Halcyon, in the Upper Arrow Lake district, A. Fowler stumbled across what may be an important discovery of lead-zinc ore. Fowler describes the deposit as being 300 ft. wide and traceable for about three miles. With associates he has taken up a number of claims and is taking out a trial shipment. The point of discovery is situated conveniently for shipping.

Rossland.—The return from the two tons of bonanza ore recently shipped to the Bunker Hill smelter from the I. X. L. mine show a yield of 296 oz. of gold and 47.5 oz. of silver, while the 20 tons of second-grade give a return of 4.195 oz. gold and 5.75 oz. silver per ton. The shippers are pleased with the treatment they have received from the Bunker Hill & Sullivan company, which paid for the whole of the gold in the high-grade ore at $20 per ounce, 96% of the gold in the second-grade ore, and charged $8 per ton for treatment. This they maintain is an improvement on the Consolidated company's terms. It made a charge of $100 per ton for treating the bonanza ore and paid for only 95% of the gold content, added to which it absorbed 3% advantage in exchange. The Kellogg smelter paid half cash and half at 30 days in U. S. funds. The bonanza ore is holding out well, being as rich as ever in both the roof of the raise and the floor of the winze. Another shipment will be made in a week or two.

Stewart.—The S. S. 'Anyox', which arrived here recently, brought a large supply of machinery for the Premier mine. It took south a consignment of 250 tons of concentrate from the Premier and a small consignment of high-grade from the Fish Creek mine, both of which went to the Tacoma smelter.——Howard Cameron has been appointed superintendent of the Silverado mine, in place of R. L. Clothier, who resigned recently. Construction work is progressing well, but it will be a race to get the tramway finished before the heavy snow, and on this depends the possibility of shipping ore through the winter.

Trail.—During the last ten days of November 7510 tons of ore was received at the smelter, 7072 tons coming from the Consolidated company's own mines. The other shippers were: Echo, Silverton, 5 tons; Horn Silver, Similkameen, 53; Josie, Rossland, 105; Knob Hill, Republic, 161; Surprise, Republic, 112; and Widowson, Nelson, 2.

JAPAN

Tokyo.—The Yawata Steel Works, in Kiushiu, is now building a plant to manufacture billets for private steel makers. Dispatches state that the construction program calls for completion of the plant about April 1924, when a productive capacity of 200,000 tons of billets per year is expected.

MEXICO

Chihuahua.—The San Pasqual de las Adargas Mining Co., operating a large group of rich properties in the Adargas mountains, about 15 miles south-west of Jimenez, is going to build a branch railroad line from the camp to Jimenez or Dolores station on the main line of the National Railways of Mexico, for hauling their ores and supplies. Some of the ores from these mines will be shipped to the United States for treatment. The company recently contracted with the Boquilla Power Co. for the transmission of electric power from its plant at the Boquilla dam to the mines.

El Tigre.—T. J. Lawrence and Benito Solis of El Paso, recently denounced the Santa Elena claim, situated about 8 miles south of here; they are engaged in developing the property.

Nacozari.—E. H. Devore has secured a renewal of the lease and bond on the Rubi mine from the owners, Marquard and Castillo. This is believed to be the famous old Juacal

Nacozari, Sonora, from the Moctezuma Copper Co.'s Mill

mine. R. H. Bartlett has been given a contract to sink the shaft to a point 50 ft. below the lowest old workings.

A denouncement has recently been made by R. H. Bartlett of a fraction of ground between the Rubi mine and the Carnaval recently taken up by C. A. Pierce of Patagonia, Arizona. This fraction has the continuation east of the Rubi vein, and has a strong surface showing.

Santa Ana.—George Fast, manager and owner of the San Julian and Tres Piedras molybdenum mines in the Sahuaripa district, is contemplating starting work with the flotation plant here. Considerable ore has been milled, and the concentrate averages better than 90%, which makes it a desirable product.

Torreon.—Americans representing New York capitalists have taken over the Reyes smelting plant, situated about 35 miles west of San Juan de Guadalupe in the State of Durango. This smelter was built in 1910 by the Reyes Smelting & Mining Co. but was forced to suspend after a few months on account of the revolution. One car of bullion was shipped. The ores treated were mined from the properties in the vicinity of the smelter, most of which belonged to the company. There is an abundance of good fluxing ores close to hand and at Valenciana, a short distance south-west of the Reyes, in an old slag dump, carrying from 15 to 20 oz. silver per ton. Repair work on the buildings and machinery of the Reyes smelter have been commenced and it will be ready to blow in within a few months. A lease and option has also been taken on a number of the mines in this district by the new company.

ONTARIO

Cobalt.—Production of silver from the Cobalt and surrounding districts during November amounted to 900,000 oz., according to preliminary estimates. The gross value of the output was $630,000, plus a premium of between 8 and 9% on United States funds. By the close of February, next, at the current rate of production, the value of silver produced from this district since the first discoveries in 1903 will reach $200,000,000.

The Hudson Bay Mining Co. having curtailed operations on its Cobalt property has completed an examination of the Cane Silver Mines in Cane township in the Elk Lake district with a view toward taking over the controlling interest provided the results of sampling are satisfactory.

A new company is being incorporated for the purpose of operating claims in the Larder Lake district on which the Crown Reserve has recently been carrying on exploration work. The Crown Reserve, Porcupine Crown, and Imperial Crown companies will each contribute to an aggregate fund of $250,000 with which to equip the property with machinery and carry out exploration and development work, which has been recommended.

Arrangements have been made to sink to deeper levels on the Violet property of the La Rose, so as to operate at the same horizon as that in which the adjoining O'Brien mine is finding large quantities of silver ore.

Kirkland Lake.—The shareholders of the King Kirkland have adopted by-laws increasing the capital of the company from $2,500,000 to $5,000,000, and ratifying the purchase of the Ferguson claims adjoining their property. This gives the company a total area of 289 acres through which the government road runs. About 100 acres will be laid out in town lots to provide homes for the miners. Modern mining equipment is being installed.

The mill of the Ontario Kirkland, having a capacity of 100 tons daily, has started producing. The company has sufficient ore in sight to keep it running for three years as development work has opened up 100,000 tons of ore averaging $15 per ton.

At the Bidgood cross-cutting is in progress on the 400-ft. level to tap the downward continuation of the main vein, which is expected to be reached at a point 40 ft. from the shaft.

Porcupine.—The Nipissing has given up its option on the Edwards property, the results of diamond-drilling being unsatisfactory. Exploration by drilling is being continued on the Rochester, where a sixth hole is being put down. Gold was found in the fifth hole.

The production of gold from the Porcupine and Kirkland Lake districts during November amounted approximately to $1,505,000. Premium on American funds being about $120,400; this would bring the total income up to $1,625,000.

Toronto.—The Order-in-Council issued by the Ontario government extending the time for doing assessment work by returned soldiers until the end of the year will not be renewed. Although no further general extension will be granted veteran claim-owners who find it impossible to perform arrears of assessment work in time may make application for an additional extension setting forth their reasons for relief.

The offices of the International Nickel Co. are being closed, at least temporarily, and executive business transferred to headquarters at New York. A. D. Miles, president of the International Nickel Co. of Canada, the subsidiary company, and other officials have tendered their resignations. This is understood to be due to depression in the nickel industry, which some time since resulted in the closing down of the company's mines and works in Canada.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. E. White was at Riverside, California, last week.

James L. Bruce has returned from Spokane to Butte.

C. B. Lakenan is spending a few days at Salt Lake City.

C. N. Schuette has returned to San Francisco from Colorado.

Roy Brown, of Tonopah, is in San Francisco for a few days.

Charles H. White has returned to San Francisco from Nevada.

L. D. Ricketts has returned from Sonora, Mexico, to Warren, Arizona.

Cyrus S. White has moved from Reno, Nevada, to Iowa Hill, California.

W. F. Deister, vice-president of the Deister Machine Co., is in San Francisco.

Robert K. Painter has moved from Stirling, New Jersey, to Auburn, California.

F. F. Mathieu is expected in San Francisco from Tientsin, China, early in January.

L. C. Trent is developing the Gooney Manor copper mine near Front Royal in Virginia.

Dan Harrington, engineer for the U. S. Bureau of Mines at Denver, is in San Francisco.

Fernando Montijo, of the Minas Pedrazzini in Sonora, is spending Christmas at Berkeley.

Henry E. Wood passed through San Francisco on his way from Montana to Santa Barbara.

W. R. Wolton is now with the Corocoro United Mines, at Corocoro, Bolivia, South America.

R. L. Agassiz, of Boston, has been elected president of the Copper and Brass Research Association.

Fred G. Farish, of the Metals Exploration Co., has returned from the Comstock to San Francisco.

Harlow D. Phelps has opened offices as mining and civil engineer in the Bashford building, Prescott, Arizona.

Albert Burch has been nominated as chairman of the San Francisco section of the A. I. M. & M. E. for the coming year.

H. L. Payne has returned to Los Angeles from Yuma, Arizona, where he was attending court relative to the fluorspar controversy.

Charles W. Stimpson, president of the Stimpson Equipment Co., has returned to Salt Lake City after a two months holiday in Honolulu.

R. S. Baverstock, of Baverstock & Payne, has just returned to Los Angeles from the Randsburg district, and will leave this week for Acton, California.

A. W. Stickney, who has been with the Russo-Asiatic Consolidated, Ltd., at Austin Friars, London, is now with the Mines de Boson, at Frejus, in France.

E. M. Rombouts, general manager for the Sarakresk Gold Mining Co., Surinam, Paramaribo, Dutch Guiana, sailed from there on November 11 for Amsterdam.

L. S. Breckon, who recently returned from Cerro de Pasco, Peru, has been appointed general superintendent for the Consolidated Mascot Mines Corporation at Hailey, Idaho.

Tingley S. Wood died in San Francisco on December 9. He was prominent at Leadville in the 'seventies and operated several important mines, including the Silver Cord and **Lillian**.

The Society of Economic Geologists will hold its second annual meeting at Amherst college on December 28 and two following days.

THE METAL MARKET

METAL PRICES

San Francisco, December 13

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95—5.95
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$90
Zinc, slab, cents per pound	6.75—7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

December 12.—Copper is active and strong. Lead is quiet and firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Dec. 6	66.50	36.37	Oct. 31	70.04	40.25
" 7	66.25	36.13	Nov. 7	69.46	39.93
" 8	63.25	34.50	" 14	67.28	38.85
" 9	64.25	34.75	" 21	68.54	38.83
" 10	65.75	35.50	" 28	67.55	37.85
" 11 Sunday			Dec. 5	67.27	37.35
" 12	66.75	35.37	" 12	65.46	35.44

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.92
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending		
Dec. 6	13.50	Oct. 31		12.68
" 7	13.37	Nov. 7		12.75
" 8	13.37	" 14		12.88
" 9	13.50	" 21		13.19
" 10	13.50	" 28		13.35
" 11 Sunday		Dec. 5		13.39
" 12	13.50	" 12		13.46

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending		
Dec. 6	4.70	Oct. 31		4.70
" 7	4.70	Nov. 7		4.70
" 8	4.70	" 14		4.70
" 9	4.70	" 21		4.70
" 10	4.70	" 28		4.70
" 11 Sunday		Dec. 5		4.70
" 12	4.70	" 12		4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York, delivery, in cents per pound.

Date		Average week ending	
Dec. 6	5.37	Oct. 31	5.07
" 7	5.40	Nov. 7	5.18
" 8	5.35	" 14	5.23
" 9	5.35	" 21	5.18
" 10	5.25	" 28	5.14
" 11 Sunday		Dec. 5	5.23
" 12	5.15	" 12	5.31

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5.09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Date	
Nov. 15	40.00	Nov. 29	40.00
" 22	40.00	Dec. 6	46.00
		" 13	52.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

DRAWING ON STORED MEXICAN OIL

Comparison of production and export of oil from Mexico for September showed that many companies are drawing from storage to supply oil for export. Crude-oil in storage is much less than 41,000,000 bbl., which represents total capacity, and may be nearer 20,000,000.

'Wild-catting' is now needed, and much of it is centring south of the Tuxpam river, and in a direct line with Potrero, Cerro Azul, Toteco, and Amatlan fields. Most of this has been started within the last year. Several difficulties previously have stood in the way of this work, including political uncertainties and legal complications.

At least 30 square miles of territory immediately south of Tuxpam river has been acquired by prominent oil companies of Mexico. Most of it has been taken up by companies which have had wells in the older fields. Some of the new acreage is split up into small tracts in the same way that part of the old producing acreage was divided. One lot, Lot 6, on what is known as the Castillo tract, is divided among nine different companies. A well is now being drilled on that tract by the Corona Petroleum Co., a Royal Dutch subsidiary.

With estimated investment of $425,000,000, approximately 650,000,000 bbl. of crude-oil has been taken out and marketed. Estimated investment to the end of 1920 was as follows, according to the Department of Commerce:

Approximately 1000 wells, drilled and producing	$100,000,000
Value of land upon which wells were located	50,000,000
Pipe-lines, railroad, and rolling-stock	50,000,000
Refineries, machinery, and buildings	50,000,000
Miscellaneous producing properties, of which the greater part belongs to Great Britain	50,000,000
Oil-tankers	125,000,000
Total	$425,000,000

American oil companies have the biggest interest in almost every branch of the industry, the following table showing the percentages:

	American %	British %	Other %
Production	66	33	1
Exports	84	16	..
Number of tankers in service	73	18	9
Tanker tonnage in service	75	15	10
Pipe-line, miles	66	34	..
Pipe-line capacity	86	14	..
Steel storage-capacity	40	60	..

MONEY AND EXCHANGE

Foreign quotations on December 13 are as follows:

Sterling, dollars:	Cable	4.19½
	Demand	4.20
Franc, cent:	Cable	8.20
	Demand	8.22
Lira, cents:	Demand	4.70
Mark, cent		0.59

Eastern Metal Market

New York, December 7.

All the markets reveal a strong tone, higher prices, and a good demand.

Copper prices have advanced about ⅛c. per pound and buying and inquiry continue satisfactory.

Buying of Straits tin has again revived and large sales at higher prices are recorded.

The lead market is firmer with a better demand for early shipment.

The zinc market has advanced and the tone is stronger.

Antimony is quiet and inactive.

IRON AND STEEL

The returns of the country's pig-iron output in November indicate plainly that the expansion in steel production in the past two months had made large inroads in pig-iron stocks, compelling the rapid blowing-in of a good many iron-furnaces.

The steel trade is taking great interest in the plans for merging seven important independent companies, representing every form of rolled products except tin-plate. The consolidation would have about 20% of the country's steel capacity, while the Steel Corporation has 45%. The new combine would have a larger share of the country's capacity in plates than in any other product.

COPPER

The feature of the week's development is the estimate that total sales for November were 190,000,000 lb. This is a very heavy movement and contrasts with 140,000,000 lb. for October. It stands as the record for the year and probably will continue so, as December is expected to be quieter. Deliveries into consumption are not yet calculated, but they were probably also heavy and perhaps the heaviest of the year. The market is strong and progressive, with prices higher than a week ago by at least ⅛c. per pound. The actual market depends on the seller, some asking higher prices than others. For early or December delivery the minimum for electrolytic copper is 13.50c., refinery or New York, and 13.75c., delivered, and for January or first quarter it is 13.75c., refinery, or 14c., delivered. A small amount might be obtained from certain quarters at ⅛c. under these levels. The large producers are all firm at or near the higher levels. Inquiry for both domestic and foreign consumption is excellent, mainly for first quarter, and buying continues entirely satisfactory, with some sellers out of the market for December and January. Sales to foreign countries continue heavy and prices are at least 14c., f.a.s.

Exports of refined copper to November 1 have been 468,215,221 lb., against 479,735,553 lb. to November 1, 1920. Germany is the heavy buyer, being credited with 184,739,354 lb. of this year's outgo, or about 40%.

TIN

A heavy business in Straits tin has again been done. On November 30 and December 1, Wednesday and Thursday of last week, as well as on Saturday and Monday, December 3 and 5, buying was excellent and the market has risen each day. On November 30 and December 1 a good business for all positions was done at above and below 30c. with some business on December 3 at the same levels. On December 5 heavy sales were put through, aggregating 500 to 750 tons, for all positions. This advance and the higher value of sterling have been factors in the market. American pure tin, electrolytic, has sold at 31.50c.

Deliveries into consumption in November were 1250 tons, with 1316 tons in stock and landing on November 30. Imports to December 1 have been 20,668 tons, against 48,093 tons to December 1, last year.

LEAD

There is more strength to the market from an increase in demand for December shipment. While prices are not quotably higher, they are stiffer. The leading interest has not changed its quotation of 4.70c., New York and St. Louis, for early delivery and is still taking business at this level in New York. The independent's prices are higher at 4.75c., New York, or 4.45c., St. Louis, and sales at Eastern points outside of New York have been made at 4.75 to 4.77½c., delivered. Lead in England continues scarce and high and the situation is full of interest on this side.

ZINC

The market is higher, but there is not much activity. There is some demand from galvanizers, who seem to need certain quantities for December consumption, and this, due to somewhat limited supplies available for sale, has caused prices to advance. Sales were made yesterday of small lots at 4.87½ to 4.90c., St. Louis, or 5.37½ to 5.40c., New York, which is quoted as the market. Production is reported to be on the increase.

ANTIMONY

There is no change to record. Wholesale lots for early delivery are nominal at 4.50c. per pound, New York, duty paid, with spot delivery at 4.55c. Jobbing lots are about ¼c. higher.

ALUMINUM

The leading interest continues to quote virgin metal, 98 to 99% pure, at 19c. f.o.b. plant. The same grade from Sweden, Switzerland, Germany, and other countries is quoted by importers at 17 to 18c., New York, duty paid.

ORES

Tungsten: No developments are recorded. Business is stagnant and prices are largely nominal at $2 per unit for Chinese ore, with others higher, depending on grade and delivery.

Molybdenum: Nominal quotations are 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: There is absolutely no demand, as stocks are large and the production of ferro-manganese is at a standstill. Quotations are nominal at 20c. per unit, Atlantic seaboard.

Chrome: With heavy stocks in consumers' hands there is no demand and quotations are nominal at $20 to $28 per net ton, c.i.f. Atlantic ports, depending on grade and other conditions.

FERRO-ALLOYS

Ferro-manganese: More interest is recorded, sales of about 1500 tons being reported. About 1100 tons of this is British and American, mostly American, with the rest sold by the Carnegie Steel Co. Quotations are $58.35, seaboard basis, for British and independent American producers, with $60, Pittsburgh, the price of the Carnegie company.

Spiegeleisen: Sales are confined to a few carload lots at $25 to $27, furnace, for the 20% grade. Stocks are declining and no fresh alloy has been made since early in the summer.

Ferro-tungsten: In the absence of activity prices are nominal at 40 to 45c. per pound of contained tungsten for the domestic alloy, with 50c. the quotation for the imported at the seaboard, duty paid.

Ferro-silicon: The market for 50% alloy is quiet but firm at $60 per ton, delivered.

INFORMATION FURNISHED BY MANUFACTURERS

COPPER'S IMPORTANCE IN DOMESTIC COMMERCE

By Thomas D. Brophy

*When the 'Santa Maria' arrived off the coast of Honduras, Columbus captured a native canoe, and among other things it contained a number of copper hatchets. After reaching a point near Panama, he wrote a report to his sovereign and, in mentioning the incident, spoke of these and other excellent examples of the Coppersmith's art, adding that he believed the country contained great mines of copper. Almost from that day forward, the mining of copper ores and the fabrication of copper metal have been important factors in the industrial and economic life of our country.

With the discovery of large copper deposits in New Jersey, Pennsylvania, and Virginia, and the establishment of rolling-mills in Boston, New York, and Baltimore, the development of the industry was rapid, and in the middle of the last century we find copper or its alloys in general use for cooking-utensils, roofing, ornamental-ware, and a thousand other uses, ranging from the manufacture of pins to the sheathing of ships. The coppersmith was as necessary to community life as the blacksmith.

With the advent of the great era of electrical development, the demand for copper jumped enormously. The production of the country was totally inadequate, the price rose rapidly, and it became increasingly difficult to secure copper at a price which made possible its use for domestic purposes. Great new copper deposits were discovered, new mines were opened up, improved mining and smelting methods were developed, but still production was inadequate to meet demands.

The situation was further complicated by a series of wars and the consequent demand for copper for munition purposes; by the development of the automobile industry; and by the great extension of interurban electric service. This enormous demand for copper resulted in an increase of production of 1,600,000,000 lb. per annum in ten years.

With the coming of the World War, the demand for copper became so great that its use in all but essential industries was expressly prohibited. Manufacturers were forced to cut out copper wherever possible and the use of the metal for domestic purposes was practically discontinued.

During this ten-year period when practically the entire copper supply was being absorbed in the development of new industries, the old established markets were entirely neglected and hundreds of substitutes were placed on the market, claiming all the virtues of copper, and selling at a considerably lower price. Intensive advertising and intelligent sales promotion work resulted in the successful marketing of these substitutes, notably in the roofing-material field. The kitchen-utensil industry also suffered.

In 1912 the average amount of copper used in automobiles of American manufacture was approximately 200 lb. per car. Today the average is less than 30 lb. per car. In 1914 a large manufacturer of screws, nuts, bolts, etc., in this country, consumed 10,000,000 lb. of brass. Last year they used less than 3,000,000 pounds.

The superiority of brass pipe, especially for hot water supply, is unquestioned, yet today brass represents only a small percentage of the total outlay for plumbing, even in our finest buildings. The plumbing in the Commodore hotel in New York cost $900,000, of which only $3,150 represents brass pipe. The plumbing in the Woolworth building cost $450,000, of which only $32,400 went for brass pipe.

In no one industry perhaps has copper and brass lost so heavily as in building, yet most architects prefer to specify copper and brass as a matter of professional pride. A recent canvass of architects in and around New York developed the fact that 137 out of 150 interviewed recommended copper as the best roofing material obtainable, 141 recommended copper for flashing and down-spouts, and 128 recommended the exclusive use of brass pipe. Architects generally would gladly use copper and brass if prospective builders understood the rare and exclusive qualities of the metals and would be willing to bear the extra expense.

Sheet-copper is the best roofing material known, being very light, absolutely impervious to the action of the elements, and practically everlasting. It is capable of being laid flat or being worked to any curve, and after being in use a short time it takes on a most attractive color which harmonizes with practically all building materials. The first cost of copper roofing is greater than that of some other materials, but over a period of years copper, with practically no maintenance cost, is considerably less expensive than any other material, and if a copper roof is properly erected it should last practically forever.

There are thousands of examples of copper roofs in service in all parts of the world. Nagoya Temple in Japan was roofed with copper 510 years ago and is today in perfect condition, and its many gabled roofs, covered with the green patina of age, have taken on added beauty every year. The dome of the State House in Boston was roofed with copper in 1831, and is still in excellent condition after 90 years exposure to the rigors of the New England climate. Christ Church, Philadelphia, has a copper roof laid in 1838, and I was recently informed that there is every reason to believe that the roof is good for another 100 years at least.

There are hundreds of less conspicuous examples of the wisdom of roofing with copper in the older sections of the country. Yet copper is rarely specified today because of a slightly higher initial cost which is saved many times over, even in the first few years of service. For other roofing purposes, such as flashing, gutters, and rain-conductors, copper is unequalled. On the Chew mansion in Germantown, Pennsylvania, one of the conductors bears the date of 1798.

It has been estimated that an average of 400 ft. of gutter and conductor pipe is used on the typical American dwelling. Made of copper, it would cost less than $200—a small item in the total cost of building a home—yet over 90% of the spouting used is made of galvanized iron, which must be replaced at intervals of not over five years, while

*Abstracted from an address delivered before the American Mining Congress.

copper lasts a lifetime. The cost of erecting copper and galvanized iron is substantially the same and the difference in initial cost is absorbed before the first replacement of galvanized iron is completed.

The use of copper in shipbuilding is as old as the industry itself. The ancients used it extensively and modern ingenuity has devised no better. Paul Jones sheathed the sides of the 'Constitution' with copper in 1803, and the old 'Granite State', having completed 75 years of service in the American Navy, is now about to be burned to the water's edge in order that the charred hulk may be stripped of a copper bottom and the copper spikes in her hull reclaimed.

Lightning-conductors, which we owe to the genius of Franklin, have been given an evil reputation by the machinations of fakirs and confidence men. Yet, the fire losses of this country due to lightning are enormous. The Department of Agriculture is constantly urging the use of lightning-conductors, and fire-insurance companies allow reduced premium rates on buildings so protected. But this great industry has been allowed to languish and become the prey of shysters. Copper as the premier conductor of electricity is the logical lightning-conductor.

Where resistance to corrosion, easy handling of expansion and contraction, absence of upkeep expense, and long life are to be desired, copper is supreme. My purpose is not to detract from the merits of other metals—all have their uses—but there are certain fields in which copper excels and we intend to do all in our power to restore the metal to its former position of dominance.

The automobile industry will return to brass when the buying public is taught to demand quality where it cannot be seen, but counts the most. Copper roofing can be revived if the merits of copper are known. Brass-plated screws can no longer pose as solid brass if the consumer is taught to demand the best.

SIZING SAND

The Allen sand-tank, manufactured by the Allen Cone Co., of El Paso, Texas, is a new form of the sand-cone, especially adapted to washing sand and gravel. The Allen sand-cone has been a standard machine in ore reduction, phosphate-washing, and similar industries for a number of years, and the principles by which it operates have been thoroughly proved. The change to the Allen sand-tank has been one of detail only, adapting it to the heavier tonnages and the rougher usages it has to meet in sand-washing plants. It has important advantages over the older forms of sand-collectors. Its greatest advantage is the simple and positive Allen automatic control. This reliable mechanism for regulating the discharge is not affected by a few pounds of sand in the wrong place, or a slight warping of the supporting timbers, such as will throw the old-fashioned tilting-box and similar machines entirely out of adjustment. In addition, the adjustment of the Allen control is simple and easily understood, and does not depend upon the careful balancing of a counter-weight.

It has also the new reduction plate, which is a most important improvement over other forms of sand-collectors. The use of this reduction plate is to reduce the area through which the current going to the overflow passes, regulating in this way the amount of fine sand settling in the tank. Provided that the full area of the tank is sufficient to settle the fine as well as the coarse sand, any part of the fine sand may be eliminated by simply moving the reduction plate. In this way the sand is classified, so that its grading may be made to meet any specifications within the limits fixed by the feed to the tank. All sand banks contain dirt and silt in varying degree, and it is rare to find a deposit from which 'run of bank' sand will be accepted by engineers for making concrete. Practically all concrete-sand is washed.

In addition to being washed, sand should be graded. That is, it should have a certain proportion of each size, from the largest that is permissible, say ¼-in., down to the finest permissible. If all the grains are the same size, there will be a much greater percentage of voids than where there is a proper proportion of each mesh-size, for the small grains will fill the spaces between the large grains, and thus reduce the percentage of voids. The more voids in the sand, the more cement must be used, for if these voids are not filled the concrete will be weak. But fine sand, beyond a certain limit, has also the effect of weakening the concrete. Hence the best concrete is made from sand which is graded to have the proper proportion of each size. Engineers claim that three-fourths of the failures of concrete are due o poor sand, and many engineers are insisting that of all the tests that are made, of materials for making concrete, the most important test is that of the sand. Sand may be produced by the Allen sand-tank to meet any reasonable specifications. It cannot, of course, put, say, minus ¼ in., plus ten-mesh grains into the sand, if the grains are not there to start with. But if the grains are there, it can modify the proportions of the other sizes to meet the requirements.

Type AN polyphase induction motors, made by the **Allis-Chalmers Manufacturing Co.**, have been well and favorably known for many years. In order, however, to take full advantage of improvements and advances made during recent years, and benefit as far as possible under all conditions of operation, the new line of Type AR motors has been developed. These range in output from ½ to 200 hp. A prominent feature is the use of cast-steel in place of cast-iron wherever practicable. The development of the electric furnace during recent years has made possible the production of high-grade steel castings true to pattern and suitable for use in machines of this kind. The castings are used for the stator end-frames, and rotor-spiders wherever the size of the motor is such as to require a spider to carry the rotor laminations.

A very efficient method of ventilation is used whereby even cooling of the internal parts is secured. This results in temperatures more uniform than in former designs and avoids 'hot spots' which have a deteriorating effect on the stator-coil insulation. High-grade insulation is used throughout. After the winding has been completed and all connections made, the stator is treated with baked-on insulating varnish, which makes the whole structure dust and moisture proof. Rotor-bar end-fastening of squirrel-cage construction generally is such as to stand the most severe conditions without developing defective joints. Bulletin No. 1118 describes these motors fully.

A ditch-blasting test in snow and ice of the new non-freezing straight dynamite manufactured by the **Du Pont company** was made during the last few days of November, near Wausaukee, Wisconsin. The ditch was blasted by the 'propagated' method and the dynamite was loaded through 8 in. of snow and about one-half inch of ice in wet soil, the temperature of which was 35°F. at the point of the load. Moreover, the dynamite used had been exposed in storage to freezing temperatures for several weeks. The results were absolutely perfect in every respect. The test is regarded as of great importance to users of dynamite for open work during the winter months. Straight dynamite has for years been the standard of the world in nearly every kind of open work, but a disadvantage has been its liability to freeze at temperatures below 50°F. Any dynamite loses part, if not all, of its efficiency when chilled or frozen, and many attempts have been made to make the explosive low-freezing. This test in Wisconsin shows that thawing, with its loss of time and attendant danger, has practically been eliminated.

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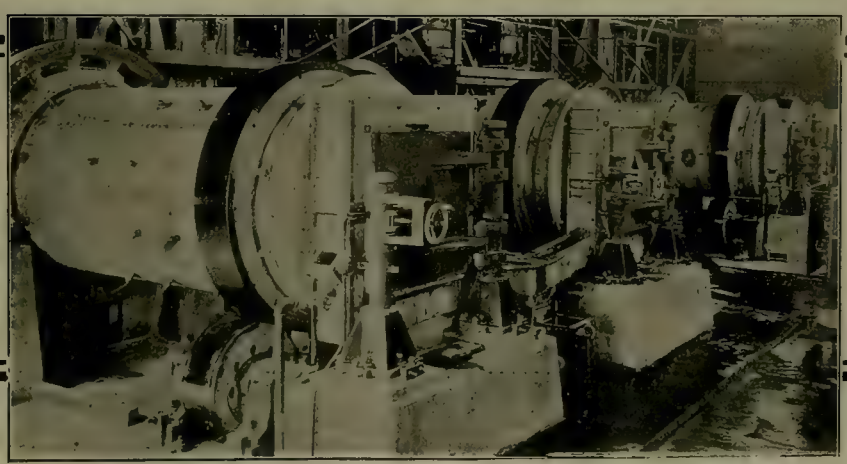


The Phelps-Dodge Corporation is Installing Forty-Two Large Marcy Roller Mills

T. A. RICKARD, - - - - Editor

ELECTRICITY is being adopted on an increasing scale in place of steam as motive power for railroads, especially in foreign countries. The latest news in this connection comes from South Africa, reports indicating that the Railway Board has decided to electrify the Durban-Glencoe line at a cost of about $25,000,000. Changes such as this will serve to popularize electricity and to promote the more extended use of its conductor—copper. The surplus is assured an early extinction.

IN our issue of December 3, on page 776, a tabulation of new flotation plants contains the erroneous statement that grinding in the remodeled Nevada Consolidated concentrator is to be done in Marcy ball-mills; likewise the flow-sheet on page 778 shows the same error. As explained on page 775, the statement and flow-sheet refer to Section 4, the most recently remodeled of the eight sections in the plant. The fact is that the mills in Section 4 were made by the Power & Mining Machinery Co. and are not Marcy mills. It is also fair to say that Section 3, remodeled a year ago, contains Hardinge ball-mills exclusively, and that the design for re-building the remaining sections for the use of flotation specifies Hardinge ball-mills.

H. G. WELLS has a virile character, as is shown by his refusal to write under dictation. He came to Washington as a representative of the London 'Daily Mail', one of Northcliffe's strident chorus. His criticism of French policy displeased his employer and he was instructed to abate his impetuosity. He resigned; whereupon the 'Mail' showed characteristic lack of taste in publishing the confidential correspondence between them. This did not close the incident, for the New York 'World', which had the first right of publication to the Wells articles, reprimanded the 'Mail' and stated that the news columns of the 'World' "had no policy except the publication of the truth". We do not like the 'World', partly on account of a Pulitzer prejudice, but we do like that statement immensely. It asserts an idea fundamental to true journalism. Mr. Wells comes out of the affair with credit.

GENERAL DAWES, known as the Budget chief, states that among the numerous suggestions sent to him, for the furthering of Federal economy, was one from a Western farmer, who said: "Abolish all these stenographer jobs and make the highbrows take most of their own dictation. There's too much letter-writing anyhow". He may have been a farmer, and the farmer is too often accepted as a synonym for ignorance of large affairs, but we find much sense in this idea. The ease with which a letter can be dictated to a stenographer is the cause of much needless letter-writing. That needs no argument. Moreover, the gentlemen in the Federal employ, as well as those employed by corporations, would save much paper, and much time at the terminals of their correspondence, if they would do more of their writing themselves in long-hand, for that is the only way to learn to write tersely and clearly.

ENGINEERS and capitalists who are interested in the resources of the mountainous districts of northern Chihuahua will be interested to learn that the Kansas City, Mexico & Orient Railroad Company's line between Kansas City and Topolobampo, on the Gulf of California, will be completed in the near future. At the present time two unfinished gaps remain in Mexico—one between Fuerte and Sanchez, a distance of 155 miles, the other between Alpine and Falomir, approximately 158 miles. We learn from a consular report that the British financial group in control of the line is ready to begin construction. Labor is cheap and plentiful, and the work will have the unqualified approval of the Mexican authorities, for it will give employment to a considerable number of men. The Government is also said to desire the completion of the road, so that there may be ready access to the north-west territory of the Republic. The work will probably take about three years and when completed will facilitate the development of a region that is now almost inaccessible, but that has been and will doubtless be among the richest mineral areas in Mexico. A number of well-known mines will be brought into closer touch with the outside world. These include the Palmarejo, the Batopilas, the Rio Plata, and the Lluvia de Oro properties in the State of Chihuahua, and the El Fuerte company's holdings in Sinaloa. In each case mining operations have been handicapped by a lack of transportation facilities.

CANADA is rapidly improving her position as a producer of gold. Production began in the Porcupine district in 1910 with bullion valued at $35,529. In 1914 the output was worth $5,190,794; in 1920, $11,862,237.

The Department of Mines anticipates that the production for 1921 will show an increase of about $2,000,000 over that of 1920. The Hollinger is crushing about 3300 tons per day for a yield valued at nearly $1,000,000 per month. The McIntyre has added to its crushing and treatment plant, it has solved difficulties in the metallurgic treatment of the ore, and it will improve the results of last year, when gold valued at over $2,000,000 was produced. Interesting and profitable developments have occurred in the lowest levels of the Dome mine, and this presages an increased output of gold in the near future. The Keeley mine is in bonanza. Four mines in the Kirkland Lake district produced bullion that was valued at over $500,000 during the first six months of this year. The Department estimates an annual yield approximating $25,000,000 from the mines in Northern Ontario in the near future. In Canada and elsewhere there is more optimism about gold mining than there is in any other branch of the mineral industry. Improvements in conditions must be sought and encouraged, not merely anticipated. Much is being done; but more is possible by a recognition of the benefits of metallurgic research and by the adoption of ambitious schemes of treatment.

AT a time when our people are foregathering for Christmas festivities and rejoicing in a happier outlook, political and economic, it may be timely to remind them of the less fortunate fate of other peoples. In a letter from a distinguished mining engineer we have been given sundry details concerning conditions at a well-known copper mine in Russia. The mine is the Atbasar, which is situated in a part of Siberia populated by the Kirghiz, a Tartar race. Recently they revolted against the Soviet government. A Red army was sent against them and subdued them in short order, because they have no weapons save lances. The Russians cut the bodies of the killed into pieces and scattered them over the steppes. Of the employees at the Atbasar mine, 38 were shot. An English member of the staff, named Yardley, was taken away on a cart with a sick Kirghiz and transported 400 miles to a verminous prison, where he had to await trial as a spy. When nearly starved to death, three months later, he was taken to Tashkent for medical treatment. From there he escaped to Moscow. It is stated that both the Kirghiz employees and the Russian work-people have remained loyal to the Atbasar company; they have taken good care of the machinery and stores, despite the fact that their own needs were pressing. Our informant tells us that trading has begun in Moscow and, although prices are high, there are signs of a resumption of industry. Swedish and German products are much in evidence. The Russians are beginning to exert themselves in the right way. This is typified by the story of the cab-driver who said: "Look at my horse, doesn't he look fine? I feed him *now* and groom him well". On being asked the significance of the "now", he replied: "Formerly the horses belonged to the Soviet; who wanted to feed or groom a Soviet horse?" The moral is that Russia has been a Soviet horse, starved and whipped, instead of being fed and groomed. We join with our informant in hoping that Russia may be on the eve of a better day.

DOES platinum really exist in the lodes traversing the newly organized Platinum mining district near Winnemucca, in Nevada, or is the district parading under false colors? It has been given a precious name, but is the name deserved? Mr. L. E. Sowers, who, according to a press dispatch from Winnemucca, is chief chemist for the Silver State Chemical Company, insists that he has proved conclusively that sundry rocks in the vicinity contain platinum. On the other hand, Messrs. W. G. Adamson and L. G. Hubbard, local assayers, and Mr. S. C. Lind, of the Experiment Station of the U. S. Bureau of Mines at Reno, maintain that if there be any platinum it is in such form that it eludes the traps that they set for detecting and apprehending it; in short, their analyses proved that the samples did not contain platinum. Apparently it has been charged, or at least insinuated, that 'salting' had been done by somebody, for the press dispatch says that "Sowers especially resents the intimation made by a number of persons that the discovery had been salted". We share Mr. Sowers' indignation; on the face of it the evidence refutes the charge. We have enough regard for the ability of the assayers who failed to find platinum to conclude that there had been no general salting. At the same time doubt rises in our mind as to the technical efficiency of Mr. Sowers' methods of analysis. Again the evidence is in the news itself, in the form of assertions credited to Mr. Sowers. He is quoted as saying that frequently "eminent assayers and engineers have been unable to make platinum determinations from samples actually containing the metal". We demur, respectfully. Quoting further, "Upon completion of the assays I obtained a small button of platinum, and am willing to stake my professional reputation upon the result". This implies the making of a straight fire-assay, which is distinctly not a dependable method of analyzing an ore for platinum. The approved procedure is to combine a fire-assay with a chemical determination. This is accomplished by adding to the crucible in which fusion of the sample is performed a quantity of silver 30 or 40 times as great as the highest suspected content of platinum—its presence is more often suspected than expected. This permits successful cupellation of the lead button, thereby leaving the platinum in the resulting silver bead. A wet or chemical analysis of the bead is then made to determine the quantity of platinum it contains, if there be any; generally there is none. The advantage of the combination method over direct treatment of the ore by wet analysis lies in the fact that an assay-ton or nearly 30 grammes of the pulp can be used, whereas one gramme is the most pulp that is practicable for a wet analysis in which the ore itself is dissolved by acids. It would be a pleasure to record proof of the discovery of platinum near Winnemucca, or anywhere else in the United States, but the preponderance of evidence so far is against Mr. Sowers.

A Christmas Greeting

If we compare conditions now with conditions as they were this time last year, and if we look back to the dark days of Christmas 1917, we shall feel not only happy but uplifted by a sense of restoration. The world has gone through pain and travail for seven long years; during this time it has seemed as if the powers of evil were increasingly in the ascendant, and as if our ideals of human kindness and goodwill were shattered irretrievably. From that darkness we have emerged. Bethlehem in Pennsylvania with its associations of death-dealing implements and coarse profiteering recedes before Bethleham in Galilee with the old hopes and dreams of peace on earth and goodwill to men. The noise of the shell-makers and the fumes of the explosives plants no longer fill the air with nightmares of hate and horror; the angel voices can be heard in the stillness of evening and a star shines as of old in the heavens from which but lately aerial navies dropped a ghastly dew. We have reached no millennium; man is still selfish and belligerent, but we have learned our bitter lesson: that fighting between the peoples hurts all of them, even the victor; and that killing of human beings by the million at the behest of a few unscrupulous leaders of men is a sure way to the suicide of our civilization. For the peace in Ireland we are grateful, because the conditions there for many years have menaced the goodwill between the English-speaking peoples, upon whom at this stage of the world's history has devolved the lead in re-organizing industry and in restoring that cheerful sanity without which life is impossible. For the friendly agreement made between the nations represented at the Washington Conference and for the first steps toward disarmament we are greatly thankful, believing that these happenings mark the ascent of man to a higher level of intelligence. We have reason to be proud that our country has taken the lead in these matters and that postponement and publicity have been accepted as essentials to the preventing of extremes of misunderstanding such as lead to the arbitrament of war. Much remains to be done, but a start has been made in the right direction, so that we may face the future with a good heart. This year, for the first time in many years, with sincerity and hope we can wish our friends all over the world a Merry Christmas.

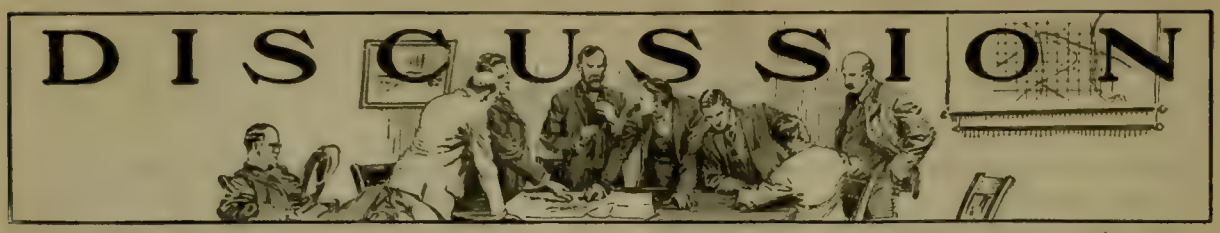
The Star Case

A suit arising from a contest for the ownership of the Star mine is engaging the interest of the mining community in the North-West. The Star is a mine near Mullan in the Coeur d'Alene region; it is close to the Hecla mine, the owners of which co-operated with the Bunker Hill & Sullivan company in acquiring the Star, which, in turn, adjoins the Morning mine, owned by the Federal Mining & Smelting Company, a subsidiary of the American Smelting & Refining Company. The Hecla company at one time sent its lead ore to the East Helena smelter, under contract with the 'A. S. & R.', as the Guggenheim company is usually designated; therefore the partnership of the Hecla and Bunker Hill companies in this venture is a menace to the A. S. & R., because it portends the continued diversion of the Hecla ore to the Bunker Hill smelter at Kellogg, only 16 miles from Mullan, to which smelter it has been going for the last four years. The litigation started four years ago; in 1916 some of the Star shareholders began to suspect that the lower levels of the Morning mine had penetrated into Star ground and that ore belonging to their company was being removed by the Federal company. Whereupon these shareholders started negotiations with the Bunker Hill management for a loan to be used in protecting themselves against the depredation of the Federal company. The Bunker Hill management agreed to make the loan, if granted an option to purchase the Star property. This arrangement having been consummated, the Star company brought suit against the Federal company. The suit went through the courts and terminated in the U. S. Supreme Court, with final decision in favor of the Star company. An accounting for the ore removed by the trespassers has recently been in progress. In course of these proceedings the question of smelting-rates was ventilated, the Star company claiming that the net value of the ore wrongfully removed should be appraised on the basis of fair rates, and not on those paid by the Federal company, the owners of the Morning, to the A. S. & R. company, which, as stated previously, controls the Federal. Next, the Bunker Hill management negotiated for an extension of time to purchase the Star mine. This extension was obtained in December 1920. Later the Bunker Hill company in turn sold part of its purchase rights to the Hecla company, this deal being made for the purpose of securing an entrance into the Star property through the 2000-foot level of the Hecla mine. In making this deal the Hecla insisted upon a 50% ownership in the Star, to which the Bunker Hill assented. Employees of the Federal company have been endeavoring to break this deal, alleging that the Star property is worthless and that the co-ownership was effected by misrepresentation. In this connection it is of interest to learn that the accounting case has just been settled by the payment of $350,000 by the Federal company to the Star company on account of the profits on the ore extracted from the Star ground. The mine-maps show that the Morning stopes are in ore up to the Star line and across it into Star ground, and it is a fact that the outcrop of the Star lode has been traced for a length of 2400 feet along the surface and also in shallow workings. Here we may state that the chief report on the Star was made by Mr. Oscar H. Hershey, whose ability and integrity cannot be questioned. The completion of the cross-cut from the Hecla into the Star, on the 2000-foot level, will open the Star mine to a depth of 3500 feet and will give both properties direct access to the tracks of two railroad systems, one of which connects with the Bunker Hill smelter. It is against this consummation of Bunker Hill policy that two of the Hecla shareholders have brought suit, with Federal assistance, it being obvious that the good understanding now established between the Hecla and Bunker Hill

companies will be a blow to the business of the A. S. & R. in the Coeur d'Alene. The claim is made, in the suit now pending, that the Hecla directors were misled by the Bunker Hill management. However, in the course of the recent hearing, at Spokane, each director testified that he had obtained independent information concerning the value of the Star property and showed himself qualified to form an intelligent opinion on the matter. It was shown also that the deal was no hole-in-the-corner affair, but one that had been discussed frankly and openly for more than a year, and that the Star property itself had been the subject of court proceedings three years ago in the town of Wallace, which is only four or five miles from the mine. One of the reasons given for depreciating the Star is because of the zinc in the ore, it being asserted that zinc as a metal of commerce has no future; and this is said despite the fact, made clear by the Harvard Committee on Economic Research, that for 17 years before the War the price of zinc rose on an average 1.43% per annum, whereas that of pig-iron and copper declined. We may add that we know the president of the Hecla company, Mr. James F. McCarthy, and we have good reason to believe that he is the last man to be hocus-pocused or to lend himself to any tergiversation. The Hecla shaft is in hard rock and is well equipped. The cross-cut from the Hecla shaft to the Star is advancing at the rate of 15 feet daily, and more than a quarter of the entire distance (8000 feet) has been covered. It is to the interest of the mining industry in the Coeur d'Alene that the project be brought to fruition. The hearing of the case was interrupted on November 25 by the illness of the Judge; it will be resumed on January 16, 1922.

Ball-Milling

Ball-milling, like other phases of metallurgical operations, may be successful or it may be unsuccessful. Some writers of articles give the impression that the machinery runs without a hitch; others include a frank statement of failures and disappointments, giving reasons and opinions in place of the customary recital of facts. Having been concerned at various times with the operation of recalcitrant machinery and the treatment of refractory ore, we are inclined to look with favor upon the latter type of engineer, for his attitude indicates a desire to describe conditions as they are, not always as one would like them to be. In the latter class we include Mr. Fernando Benitez, the first installment of whose article on ball-milling and flotation in Chile appears in another part of this issue. Mr. Benitez describes much that will be of interest to metallurgical engineers and ore-dressers; his comments will provide food for thought and discussion. We appreciate the fact that trouble arose from the operation of a combination of the front halves of two Ferraris ball-mills, especially because the tires of the composite machine could not be turned true after being assembled. Mills of this design, in which the weight is carried on tire-and-roller bearings, often have given trouble, usually on account of the position of the supports below the centre-line of the apparatus and the difficulty experienced in keeping them clean. Nevertheless, this type of bearing has proved to be satisfactory elsewhere, especially if a slow speed be practicable. The compromise made by the manufacturers of the Marcy mill—a tire-and-roller support at one end and a trunnion-bearing support at the other—is not wholly new; a somewhat similar combination was adopted by Krupps for the design of tube-mills many years ago, and may not have been original with them. The tire-and-roller support was arranged at the discharge end, and permitted the use of a screen of large diameter. This facilitated entry into the interior of the mill without removal of one of the man-hole doors, which is usually a difficult operation. It also made possible the prompt discharge of pieces of ground or broken pebbles that had been reduced in size to such extent that they were of no further use in the mill, but rather a hindrance to the efficient reduction of the ore. Some difficulties in the operation of the machine arose from the cause mentioned by Mr. Benitez. Moreover, the pulp could not be maintained at the proper height. The level of discharge, almost at the periphery, resulted in the prompt drainage of the pulp in the mill, with the result that the pebbles at the discharge-end had little to do, and so wore against one another. Mr. Benitez compliments the manufacturers of the Hardinge conical mill on the mechanical perfection of the machine and the efficiency of its operation; he likewise comments favorably on the Allis-Chalmers granulator, but he questions the need for the variable-discharge diaphragm, arguing that the level of the pulp in the mill can be regulated by modifying the moisture content; but would the degree of moisture required to keep the pulp at the proper level, with all the plugs removed, be the amount that would invariably ensure a high grinding efficiency? The question of liner-bolts is also discussed, thereby reminding us of early experiences, when we neglected to operate a newly-erected mill, without ore, for a sufficient length of time to ensure the smoothing of rough edges on the surfaces of bolts and liners. This practice permits adequate tightening before regular operation with a gritty pulp is commenced, for otherwise the sand works its way between liner and shell and so aids leakage. We like the type of liner-bolt favored by Mr. Benitez; it might be adopted more generally. Interesting comments are made anent the effect of varying the capacity of ball-mills by altering the size of the feed. The remarks on the use of the Symons disc-crusher are pertinent, for it was observed that long, flat, and slaty pieces of ore were produced; these were easier to crush in the ball-mill than were the more cubic pieces produced by the jaw-crusher. This, by the way, is one of the reasons why the product of a disc-crusher is suitable for leaching; a proportionately greater surface of ore is exposed in the form of pieces of large surficial area. Percolation is not hindered by the presence of an excess of slime that results from undue comminution and hindered discharge; the extraction of the soluble is at a maximum because of the availability of the material to be dissolved.



A Correction

The Editor:

Sir—I note on page 777 of your issue of December 3 the name of the designer of the Boston-Montana mill is given as H. S. Gieser. This is an error, as Mr. Gieser is mill superintendent for the company, whereas O. B. Hofstrand, of Salt Lake City, is the designer of this plant.

E. SHORES.

Salt Lake City, December 3.

[Since receiving Mr. Shores' letter we have also had a letter from Mr. Gieser requesting that a correction to this effect be published. We regret the error exceedingly. EDITOR.]

Russian Placer Mining

The Editor:

Sir—Mr. R. S. Botsford's letter in your issue of May 14 set me in a state of perplexity from beginning to end, as he misinterpreted all the passages in my articles that provoked his rebuttal.

To start with, Mr. Botsford maintains I am wrong in stating that want of capital is responsible for the adoption in Russian placer mining of a hand-to-mouth policy. Such policy is not typical of Russia alone, but is adopted in every branch of industry, all over the world, where there is need of recovering expenses as quickly as possible, and this need is an inevitable consequence of the lack of working capital. Contrary to this elementary economic rule, Mr. Botsford affirms that I have misplaced cause and effect, and that "it is the lack of adequate prospected reserves that causes capital to be withheld". Does Mr. Botsford really think prospecting costs nothing, and that the ascertainment of adequate reserves sufficient to warrant a costly plant—a dredge, for example—can be done without expenditure of capital? Mr. Botsford judges the financial position of Russian placer mining from his work at Nicolo Pavda, and a visit to the Lenskoie property. These two concerns are not at all representative of Russian placer undertakings, as they were both in exceptional financial conditions. The former concern had just been founded at the time Mr. Botsford took up the work at Nicolo Pavda, and, therefore, the company had all its paid-up capital free at its disposal to start operations, while the Lenskoie company was supported by strong financial groups. In opposition to these two companies are all the other placer-mining enterprises in Russia, the majority of which are individual undertakings, or partnerships, without any financial backing. The other existing stock companies, about a dozen in all, are struggling against chronic financial troubles. Mr. Botsford, evidently, confounded two things: the foreign capital looking for investment in Russian placer mines, and the working capital the existing placer undertakings have at their disposal. In my article I had, obviously, the latter in view, and it will take Mr. Bostford many years more work in Russia before he can get a clear insight in the economic and financial position of Russian placer mining.

Entering into a lengthy explanation of the advantages of proper prospecting, Mr. Botsford forces an open door. Extensive prospecting has been done on the Lenskoie property long before Mr. Botsford visited it, and the 29 Keystone drills in possession of the company are a proof thereof. We all know the value of "proper prospecting", but however useful prospecting data together "with the other necessary data" may prove in dispelling ignorance of local conditions, they can only present suggestions as to the best means for overcoming difficulties of transport; they do not eliminate them, nor solve the transportation problem itself. As I said plainly (page 458), the Lenskoie company has the alternative of organizing an expedition to the mouth of the Lena river, or of transportation over the inland route. The latter means shipping the dredge from America to Nikolaievsk at the mouth of the Amur, and there transferring into vessels to be towed up the Amur river, some 2500 miles, to Stretensk, with probable trans-shipment on the way into vessels of smaller draught, on account of the numerous bars and low water-level on the Shilka in the latter part of the journey, a distance of some 800 miles. At Stretensk there will be another transfer into railway-cars for Irkutsk, and there a transfer to motor-trucks and horse-sleighs to transport to Zhigalovo (250 miles). At this point the dredge goes into river steamers and barges for Bodaibo, and finally it is transferred into railway-cars that take it to the mines. Altogether seven times (unloading at the mines included) handling some 2500 tons of bulky machinery; and it is to be noted that none of the transloading places within Russian territory is properly equipped with cranes or other lifting appliances, and that the construction of the vessels on the Lena (and probably of those plying on the Amur) has to be changed, as all these vessels are destined mainly for transportation of dry substances (flour, oats, etc.) and are not suited for shipment of bulky goods. Moreover, the inland transportation from Irkutsk to Zhigalovo will require the reconstruction and reinforcement of all bridges on this road, and if transportation is intended

during summer time with motor-lorries, a fundamental repair of the road itself is indispensable, especially on the approaches to the Lena river, where considerable blasting will be necessary, as in many places the road is jammed between the edge of the water and high vertical cliffs, and is so narrow that two *tarantasses* (*tarantass* is the Russian three-horse coach) with a gauge about 3½ feet cannot pass abreast.

Vladivostok as a landing port, or the route through Petrograd or Libau, or other Baltic port, and thence by Trans-Siberian railway to Irkutsk, will hardly be more advantageous, as, although it obviates the repeated transfers to some extent, the freight is higher than by way of the Amur river, and the most difficult part of the transportation, from Irkutsk to the mines, remains the same. On the other hand, the voyage to the mouth of the Lena over the Arctic Ocean, although it has been done a few times by special expeditions, is not a commercial route, and the freight and insurance will be very heavy, if there be an insurance company that is willing to run the risk at all. Taking the above into account, I think everybody will agree with me that the transportation to the Lenskoie property of a 17-ft. close-connected Bucyrus dredge has all the characteristics of an "experiment", that is, to put to the proof if within reasonable limits of time and money machinery as heavy and bulky as a 17-ft. close-connected bucket-dredge can be taken to such a remote place. It is easy "to forget the cost for a moment, and think of the profit", but in this particular case it will be wiser to think of the profit when the dredge is safe and on the spot. In any case, no other Russian placer-mining concern, except the Lenskoie company, was financially strong enough to undertake such a transportation problem, the solution of which implies an expenditure of four to five million gold rubles, that is, an amount equal to the cost of the dredge, as pointed out in my article, which on the question of transportation in Siberia does not give occasion to one-sided conclusions, and I regret Mr. Botsford did not interpret my meaning correctly.

As to the working of the dredge in question, I am less optimistic than Mr. Botsford, having had good opportunity to examine closely the ground that it is proposed to dredge, as on my arrival at the Lenskoie mines drifting was going on in the area to which Mr. Botsford alludes. This area was not "abandoned as unprofitable by hand-work", as stated by Mr. Botsford. It could be drifted with the same normal profit as the other areas under exploitation, but I considered it bad policy to mine ground soaked with water at heavy expense for pumping (about 300 rubles per day) when free drainage was obtainable in a year or two, in consequence of the advance of the underground workings a little farther downstream, and the ground could then be drifted at considerably smaller cost. Therefore, one of the first dispositions I made, when I took up the direction of the Lenskoie mines, was temporarily to stop drifting operations in the area in question, and intensify the work on the other drift-mines instead.

The thickness of the alluvium in this portion of the Bodaibo valley is from 80 to 100 ft., and permanently frozen layers and bodies of lenticular shape occur. The coarse gold lies directly on the bedrock, which is very uneven, the cavities being often so small that owing to the sag of the bucket-line the buckets cannot get at the richest gravel concentrated at the bottom of these pockets, unless the bedrock is broken up to a sufficient depth. It is doubtful whether this can be done successfully, that is, economically, the schistose bedrock dipping down-stream, and presenting a hard smooth surface difficult to attack. In wide flats and flood-planes with such bedrock the dredges can work in a direction down-stream, so as to break up the schist from the edge, but this is not advisable in a comparitively narrow valley like that of the Bodaibo, particularly in the portion proposed for dredging, where frequent impetuous floods would endanger the dredge, and run it aground each time, carrying the tailing under the boat.

Mr. Botsford contends that all the conditions adverse to dredging on the Lenskoie mines will "not cause insurmountable difficulties". I agree with him, that in the present stage of engineering no difficulties are insurmountable, from a technical point of view, but in mining as a business the crux of the question is the money side of it, as so saliently set forth in H. Foster Bain's excellent address delivered before the Michigan College of Mines.* Under the conditions described there are far more chances against a success in dredging at the Lenskoie mines than for it.

This, obviously, does not mean that I am against the use of dredges in placer mining in general, otherwise I would not have introduced this method in Russia even before gold-dredging was established in America, but I do not consider dredging a panacea, the application of which will make every placer mine a profitable enterprise. I remember well the decision of the Second All-Russian Congress of gold and platinum miners in 1915, having been elected chairman of the Technical Section, regarding the great number of dredges wanted for placer mining in Russia, but I also remember that more gold has been dug into the ground by dredges than out of it, and, I think, every mining engineer should keep in mind the advice given to our young friends by Mr. Bain in the address above-mentioned, that "it is frequently good mining practice, to indulge in what is bad engineering practice".

I can find no explanation as to how my article could give an excuse for Mr. Botsford's insinuation that I do not favor modern labor-saving methods, dredges included. So far as the Nicolo Pavda dredges are concerned, I may inform Mr. Botsford that in November 1912, shortly before my departure for the Lena, I. A. Losieff, co-partner in the Nicolo Pavda estate and founder of the company which then undertook its exploitation, and whom Mr. Botsford knows very well, invited me to give my opinion before the board of directors of the newly founded company, as to what methods

*'M. & S. P.', May 7, 1921.

of working the placer deposits of the property should be adopted. I strongly advocated dredging, and I have every reason to suppose that my advice was not without influence on the decision to place the dredges at Nicolo Pavda. I did not, of course, determine the type of dredge, nor whether the driving power should be electricity or steam, as a decisive opinion in this respect required careful investigation of the entire set of conditions, but I am certainly in sympathy with the choice of the former, the more so that it was planned to install a number of dredges, and erect a common power-plant close to the working-areas. It is to be regretted that owing to *force majeure* this plan could not be carried out to its full extent, and the company had to be satisfied with a mixed installation of only one electric and one steam dredge, which in no way leads to economical operations.

As to the work of these two dredges, Mr. Botsford pretends that the comparison of the results obtained offers a convincing proof in favor of the general use of electric dredges. In fact, Mr. Botsford compares the performance of a modern dredge, I suppose one of the last ones built in America, and designed according to up-to-date experience in gold-dredging, with that of a boat the drawings of which go more than fifteen years back, when they were secured from the Bucyrus company by the Putiloff works (Petrograd), which have manufactured in all some ten dredges of this obsolete design, without introducing any noteworthy change or improvement. It is evident that under such circumstances there cannot possibly be comparison as to the superiority of one driving power against the other, much less a "direct comparison", as Mr. Botsford contends. The digging apparatus on the Putiloff boats is satisfactory; but that the 5½-ft. steam-dredge was digging just half the yardage of the 7½-ft. electric one can only be attributed to serious defects in the steam-plant of the former, the yardage having nothing to do with the nature of the driving power, as fully explained in my contribution to your issue of October 1. That serious defects really existed in the power-plant of the steam-dredge is proved by its quite abnormal consumption of fuel. I saw the Putiloff dredges at work on the Ivdel river (Northen Ural) and at the mines of the Compagnie Anonyme de Platine, a neighbor of the Schouvaloff property, and later, in 1911, when the installation of one more dredge on the latter was contemplated, I refused flatly even to consider the acquisition of a dredge that the Putiloff Works offered for sale. It is likely that this same boat was acquired later by the Nicolo Pavda. For the rest, Mr. Botsford seems to over-estimate the performance of the dredges at Nicolo Pavda, especially the electric one, ascribing to it the main portion of the huge dividends of eight million gold rubles declared and paid in 1917. Fortunately, he gives the data necessary to verify his judgment. The electric dredge, Mr. Botsford states, digged regularly 3000 yards of 32c. ground at a cost of 8c. per cubic yard. Taking 120 days of effective work, which is about the maximum at Kytlim (Northern Ural), the profit made by the electric dredge amounted to some 200,000 rubles, and, say, half as much by the steam-dredge, altogether, say, 300,000 rubles, while "the assistance given to this result by a paper factory and sale of wood" is manifested by a profit of 7,700,000 gold rubles. A generous "assistance" indeed.

The exaggerated importance that Mr. Botsford attributes to dredging at Nicolo Pavda is partly due to incorrect information as to the work previously done on the property. My connection with Nicolo Pavda was a very short one (about 11 months) at a time when I was managing the Schouvaloff mines, not before leaving for them, as stated by Mr. Botsford. The then proprietor of the Nicolo Pavda estate, A. Vorobieff, seeing that the Schouvaloff mines, which during a number of previous years had given an annual loss of some 200,000 to 300,000 rubles, were within one year converted into an enterprise subsequently yielding yearly twice as much profit† by the methods applied by me, and so disdainfully discarded by Mr. Botsford, asked me to act as consulting engineer, and supervise the placer-mining operations at Kytlim. I was handicapped, however, as soon became evident, by the owner being more interested in the exploitation of the forests than in the working of the platinum placers. I saw that little could be done, and, therefore, when my suggestions were wilfully ignored, the result being a break-down causing a delay of six weeks at the very heart of the operating season, I resigned. The bedrock tunnel to which Mr. Botsford alludes was not started by me; on the contrary, I stopped this work, as it was not justified, having been initiated previously on account of the results of a solitary prospecting pit, sunk by one of the former local managers. These details, I admit, are hardly of interest to your readers, but I wish Mr. Botsford, next time, would base his criticism of a personal nature on exact information.

In conclusion, I emphasize that nowhere in the course of my articles do I set "light" dredges in opposition to American, or Californian ones, because the term "light" conveys the idea of a lack of strength, and does not indicate the peculiarities of design. I consider the only proper terminology to be 'close-connected', or 'Californian', type in contrast with the open-connected, or 'New Zealand', type. The latter are not necessarily light dredges.

L. A. Perret.

Yokohama, November 6.

Wetting and Amalgamation

The Editor:

Sir—Mr. Dolbear's query in your issue of November 12 raises an interesting question. If it is meant that in treating any ore containing gold, the mercury would attach itself to the gold in preference to any other metals present, there is some analogy, since in flotation oil selects metallic minerals in preference to any gangue matter. But if the view is held that mercury attaches itself to

†In the years 1910 to 1912, when the price of platinum increased, the net profit reached 1,400,000 gold rubles.

gold as oil does to a mineral, then I should hold the contrary.

An amalgam is an alloy of quicksilver, a liquid metal, with a solid metal, generally gold. This alloy is solid—that is, plastic—or liquid according to the quantity of mercury present. The gold is actually dissolved, and there are three stages in this action, namely, (1) coating, (2) penetration, and (3) solution. What might be termed the 'pores' of the gold absorb quicksilver to saturation point, after which follows a breaking up of the particles, then their solution. Factors in this process are size of gold, freedom from any coating that might prevent or hinder amalgamation, and time. Some coarse gold, unless ground by some means, never really goes into solution in quicksilver, but it is more or less penetrated by the latter. The change is not chemical, nor is it mechanical, but it might be termed physico-chemical. The structure of the gold is changed by ordinary mortar-box and plate-amalgamation, although it would appear that flaky gold from placers and dredges assumes more or less its original form after retorting, yet it has been penetrated by the quicksilver (perhaps Charles Janin, C. W. Gardner (Yuba), and L. D. Hopfield (Natomas) could enlighten us on this point).

Take the exceedingly fine gold contained in the Alaska Treadwell, Homestake, and Rand ores: although this is rarely visible to the eye, mercury catches it with ease and dissolves it. After retorting, this or any other mill-gold appears as a homogeneous mass, naturally more or less porous.

When mercury is applied to a copper plate, it first coats and then penetrates, as is well known to all millmen. In doing this, it also carries some gold into the plate.

To prove my statements, Messrs. Thissen and Voorhees amalgamated some fine and coarse gold. The amalgam was squeezed, and that from the fine gold was observed under the microscope. At first the individual grains could be detected coated with mercury, but in time these grains assumed a globular form, showing that the quicksilver was dissolving the gold. A piece of amalgamated coarse gold was broken, and the microscope clearly showed penetration of the gold by the mercury. The excess quicksilver after squeezing out amalgam was then retorted in a flat porcelain dish. This is where the microscope proved whether gold was merely coated or dissolved by quicksilver, and showed that the gold was no longer in granular form, but clearly precipitated from solution. This, I take it, is proof.

In flotation, the sulphides of an ore are wetted by oil and are thereby separated from the gangue, and the resultant product is simply a mechanical mixture of oil and minerals. Oil has no dissolving effect whatever on metallic minerals. It simply coats the sulphides, but does not penetrate them as quicksilver does. Oil can be separated from the collected minerals, leaving them behind, but gold cannot be separated from mercury except by retorting the amalgam.

M. W. von Bernewitz.

Pittsburgh, November 17.

McFadden Bill

The Editor:

Sir—In your issue of November 26, commenting on a letter from S. J. Kidder, you refer to the unfairness of the practice of the United States Mint in selling gold at a price far below the cost of production, as being comparable with that which the 'M. & S. P.' suffers by reason of the unduly high cost of paper. Surely you would not seriously maintain the two things to be comparable? The injustice to the gold producer is one committed by the State itself, and is therefore irremediable excepting through the agency of the State: the other is incidental to the ordinary course of business, and remediable by the operation of the law of supply and demand.

I have long maintained that, apart from the McFadden bill, Congress should remedy this particular injustice to the gold producer. It may be advisable, in view of the necessity for maintaining the gold standard without fluctuation, to preserve unchanged the quantity of gold in standard coin, regardless of the hardship, at times of high cost, to the miner who produces the gold; but I can see no corresponding necessity for compelling him to produce, at a loss, the gold used in the arts. The proper function of the Mint is to coin into money the bullion deposited with it. It should not store gold for the benefit of the Federal Reserve Bank, nor sell it to manufacturers of jewelry. The law should specifically forbid the destruction of the money so coined. The existing law forbids its defacement or mutilation; but the Treasury construes this provision as not including total destruction.

I have heretofore pointed out that gold producers have, in some measure, the remedy in their own hands. They should arrange, in concert, to deposit bullion in the Mint, withdraw gold coin to an equivalent amount, and put it into circulation by paying it out as wages, etc. Precisely how much of a premium this would compel the manufacturers of jewelry to pay, I do not know; there would certainly be some premium, due to the cost of melting, loss in weight of coin, etc. It is possible that the fashion of using gold coin would rapidly extend, at all events throughout the Western States; in which event the jewelry trade might conceivably be forced to purchase foreign gold. The plan should, in my opinion, have been tried out long before this.

George E. Collins.

Denver, December 6.

On the shores of the Dead Sea and between Jerusalem and the Nebi Musa is found a peculiar stone, commonly used in making souvenirs, states a consular report. The Bedouins have used this for several years as fuel, and it is reported that during the War it was so used by the Germans. The stone is called Dead Sea stone or 'stinkstein'. In the Yarmouk valley in northern Palestine are also found vast quantities of an oil-impregnated shale. When burned this shale leaves a fine quality of lime, which, when air-slaked, is said to be suitable for building purposes.

CONCENTRATING PLANT AND SMELTER

Ball-Milling and Flotation at Catemu, Chile—I

Milling Operations

By F. Benitez

The Catému valley, where most of the mines of the Catému company are, is in central Chile. The mines are situated advantageously, for the district is rich in agricultural produce, is well irrigated, and is, therefore, thickly populated; the climate is temperate. The company's new smelter at Chagres is on the branch line of the Central Railway of Chile; it starts at Llay-Llay, on the Valparaiso-Santiago line, and connects at Los Andes with the Transandine railway. The mines, mills, and smelter were the property of the Société des Mines de Cuivre de Catému, a French limited liability company, with a capital of five million francs; about a year ago it was sold to a Chilean syndicate. Previous to the discovery of the flotation process, several attempts had been made to concentrate the ores. Lixiviation by sulphuric acid was tried on the oxidized ore of the Verde mine, but the results were unsatisfactory, and the plant was soon dismantled. Later, a gravity-concentration mill was erected at La Poza, where the old smelter was situated, but proved a total failure. The mill was re-designed and machinery was purchased, but this was never erected, perhaps through lack of faith. The failure of the ordinary concentration mill is not surprising when the inefficiency of some machines is considered.

The copper minerals in all but one of the Catému ores are finely disseminated throughout the gangue, so that it is necessary to grind them finer than 100-mesh to liberate the sulphides. The successful application of the flotation process to the treatment of copper ores and the satisfactory recoveries obtained on slime in the United States and by the Braden Copper Co. in Chile directed attention to the possibility of using flotation as a system of concentration for the Catému ores. Laboratory tests proved the amenability of the ores to the new process, and were satisfactory enough to justify the erection of a small plant to treat the output of the Mantes mine. Consequently, plans were prepared for a 70-ton flotation mill, utilizing in great part the old machinery and the old site. This mill was defective in many ways and should never have been considered other than as an experimental unit. But it served as a trial mill, and in addition was able to pay for itself, and even to make a profit. This was due in great part to the keenness, foresight, and energy of E. D. Pope, who designed and erected the Poza and Chagres mills and was the general milling superintendent until February 1920.

The Poza plant treated, from the time of its erection at the end of 1916 to December 1919, 55,000 tons of ore assaying 3.5% copper, of which 0.46% was oxidized. The concentrate assayed 16.3% copper, and the total recovery was 80.6%. A rough outline of the Poza flow-sheet was as follows: The ore was crushed in a 9 by 15-in. Dodge

crusher to 1½ in. Two 26 by 12-in. rolls in series further reduced it to ¼ in., at which size it was fed to an 8 ft. by 30-in. Hardinge pebble-mill, working in closed circuit with a drag-classifier delivering an 80-mesh product. The overflow from the classifier was laundered directly to a 12-box, standard, belt-driven M. S. machine. The size of the agitating-boxes was 18 in., with 12-in. agitators. The first five boxes made a finished concentrate, and the pulp from the other seven overflowed and was returned to the head of the machine. The tailing was divided into sand and slime in a Dorr classifier. The sand went to a Wilfley table, and the slime to two standard Callow cells in series. The table made a finished concentrate, but the overflow from the Callow cells was cleaned in a smaller air-cell, which made a finished concentrate and a middling. The results obtained at the Poza plant, though not satisfactory as to recovery, were encouraging enough to justify the erection of another mill at Chagres, where

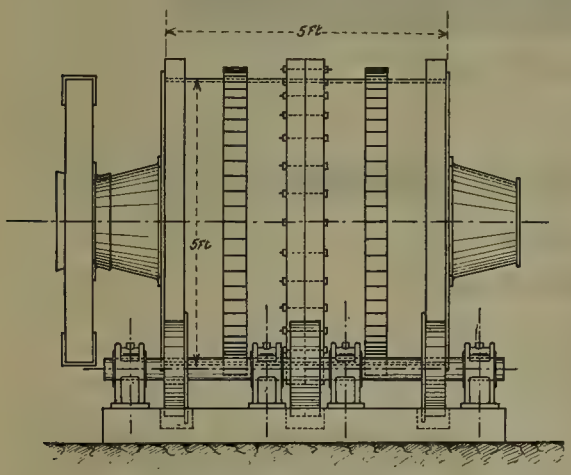


FIG. 1. THE ALTERED FERRARIS MILL

integration by rain; a plaster coating made of 1:3 mixture of cement and sand was added outside. This construction, which is used throughout central Chile, has the advantage of cheapness; moreover, Chilean masons are experienced and quick at this kind of work. It has the disadvantage, however, that frequent repairs are needed; over long periods of time it will prove to be more expensive than corrugated iron.

FLOW-SHEET. The ore is brought from Curimon to the Chagres station, a distance of 30 km., in the ordinary 20-ton trucks of the State railway. At Chagres it is shoveled from the railway car into one-ton Decauville cars and dumped into a *cancha* or concrete plat, which serves as a receiving-bin. The capacity of this plant is 400 tons. The ore is taken to the mill-bin in half-ton

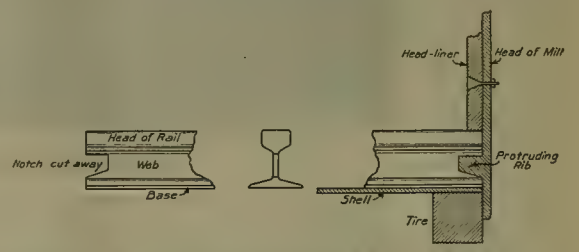


FIG. 2. RAIL LINING

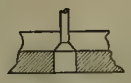


FIG. 3. LINER-BOLT SUPPLIED

FIG. 4. LINER-BOLT SUGGESTED

the company's new smelter was being constructed, to treat the output of the Caracoles mine. This mine is not in the Catému group, but is on one of the lower spurs of the Andes (called Rinconada de Los Andes) in the Aconcagua basin. The ore has to be brought eight kilometres by bullock-cart to the Curimon station on the Llay-Llay Andes branch railway, and another 30 km. by this railway to the mill at Chagres. Because of the heavy cost of transporting the ore to Chagres, the mill should have been built at the mine, where a favorable site was available. By so doing the company would have saved the difference in the cost of transport between ore and concentrate, respectively.

MILL-SITE. The Chagres mill was constructed on a flat site, which had the further drawback of being situated on the old bed of the Aconcagua river—an unsatisfactory foundation on which to erect heavy machinery. The building itself covers 3000 sq. ft., and is of local timber, oak and poplar having been used throughout. Oregon pine would have been preferred, but owing to the War none was available in Chile at the time. The walls of the building were built of adobe on edge, to prevent dis-

cars, and is weighed before dumping. A large amount of re-handling and shoveling is necessary before it reaches the concentrator bin; all this would have been avoided had the mill been erected at the mine.

Most of the machienry used in the Chagres mill was old-fashioned. The M. S. machine and the Frenier pump were new, and were the only units that never gave trouble. The altered Ferraris mill calls for special comment, for the trouble it gave, and also because the kind of support adopted is coming into favor again, in connection with some types of roller-mill. The manager did not wish to buy a new mill for the Chagres concentrator, so it was decided to make an ordinary overflow trunnion-discharge mill by bolting two Ferraris shells together, but to keep the old under-carriage. The mill would not be suspended from the trunnions, but would run, like the true Ferraris, on rollers or carrier-wheels. It was not possible to use the manganese-steel shell-liners of the original mill on account of their small length and design, so a lining made of heavy railway rails (50-lb.) was designed by Mr. Pope. The method of fixing the rails was the same as for the shell-liners of the original mill. The

Ferraris-mill heads carried a protruding rib around the periphery on which the shell-liners rested. These were held in position by the head-liners. The head-liners were fastened to the heads in the ordinary manner by means of countersunk bolts. Thus the whole of the shell-lining on the Ferraris mill was secured by means of the head-liners and the heads. In order to hold the rails in place they were sawn to the right length (59 in.), and a notch was cut in the web of each to fit exactly into the protruding rib of the head and at such a height that the base of the rail rested on the mill-shell. When all the rails were in position, the end was closed by bolting the head to the mill-shell, and a rich mixture of concrete and sand was poured in around the rails and allowed to set. The lining never gave trouble; it wore evenly and well. I have seen lately* that the same type of lining has been used by E. B. Morse with much success.

The diameter of the Ferraris shells without the lining was 5 ft. 1 in., and with the lining 4 ft. 3 in. (5 in. for each rail). The length of the two shells together was 4 ft. 10 in. inside the liners. Therefore the performance of this mill can be compared with that of a 5 by 5-ft. cylindrical mill. However, the large diameter of the feed and discharge cones (23 in.) reduced considerably the effective available volume of the mill for the load of balls, so that the mill would carry only 4200 lb. as a maximum. The original assorted load of balls was as follows:

			Total weight
132 balls	2½ in. to 3½ in.,	average weight 4 lb.....	530 lb.
114 "	3½ " " 4½ "	" " 9.7 lb....	1110 "
160 "	4½ " " 5 "	" " 16.3 lb....	2600 "
Total weight			4240 "

As the mill had to work in closed circuit with the drag-classifier, the feed-cone was fitted with a two-way scoop-feeder of 34-in. radius, made at the company's workshops. Lack of head-room from the crusher to the centre of the mill made it necessary to feed the coarse ore into the feed-box, which was unorthodox practice. The mill ran at 28 r.p.m., and was belt-driven from a 60-r.p.m., 13-amp., 2500-volt induction motor. Although the mill was a success metallurgically, for it did the work it was designed to do (40 tons per day from 1½ in. to 80-mesh), it was a complete failure from a mechanical point of view. The rollers broke under the terrific vibration; the stoppages were frequent and lengthy, as tackles and jacks were the only means available for pulling the mill to one side in order to reach the broken roller. Because of frequent breakages it was decided to replace the hollow rollers by solid ones. As the scoop was blamed for the trouble by the mechanical section, though it was entirely innocent, a bucket-elevator was inserted between crusher and mill. The real cause of the trouble lay, however, in the unequal diameter of the steel tires, which made the mill wobble on the rollers. If the tires of the two short mills, after coupling, had been turned as a single unit it is possible that the breakage of the rollers would have been avoided, or at least reduced considerably. The periodical turning-down of the tires and rollers would have been unavoidable, however, for they wore unequally. At the feed-end of the mill, sand from the classifier would lodge between the tire and the roller, causing them to wear more rapidly than those at the other end. On one occasion, after the mill had been in operation for four months, the three tires were measured. The one at the feed-end was found to be 7 mm. smaller than the one at the discharge end, which always remained cleaner.

The speed of the mill was reduced to 23 r.p.m. in order to minimize the vibration without unduly reducing the capacity of the mill. Minus the scoop and with the solid rollers the mill ran more smoothly than previously, but the elevator gave trouble because of the sticking together of the feed from the crusher, which was dry, with the returns from the classifier, carrying 25% moisture, in the boot of the elevator. The ore, being clayey and sticky, gradually filled the boot and buckets. To avoid this, the scoop was again fitted to the mill, but this time the coarse ore from the crusher was laundered to the centre and only the classifier return was scooped. With the dry feed, the elevator worked as well as could be expected; but I would never put an elevator in a mill; it is a source of trouble and annoyance, no matter how well designed. With solid cast-iron rollers, and with the feed going in at the centre of the scoop, the mill worked fairly well; but after it had been in operation for some time the tires and rollers wore unequally, causing the middle tire to hammer on its supporting roller; this hammering rapidly crystallized the steel of the carrying-shaft, which always broke inside and at the centre of the middle roller. Once the tires had worn unequally, shaft after shaft was broken; on one occasion both shafts snapped at the same time. The shafts always broke at the centre of the middle roller, in spite of the fact that the roller-carrying shafts were of 3½-in. diameter, of mild steel, and that both key-seats and keys were accurately cut. The keying of the rollers to the shafts had to be done carefully and the keys driven home true and hard, otherwise the rollers would loosen rapidly. The bill for direct repairs of these mills was heavy; besides, the mill was idle about one-third of the time. In view of the hopelessness of making the altered Ferraris operate satisfactorily it was decided to buy a trunnion-suspended ball-mill to replace it. I have dealt at length with a type of mill support that is today almost obsolete, not only because our experience may be of interest to others, but because I have noticed of late a tendency on the part of manufacturers to come back to it, at least in connection with rod-mills. The Marathon mill, described by M. F. C. Blickensderfer in Vol. LV of the Transactions of the A. I. M. E., has almost the same support as the Ferraris, that is, tires supported by and revolving upon rollers. The author, in his description of the mechanical defects of the original mill, mentions the roller-bearings as unsatisfactory and alludes to the excessive vibration that was caused by a lack of rigidity in the understructure.

*'Steel Rails as Ball-Mill Lining.' 'M. & S. P.', April 2, 1921.

No trouble seems to have arisen in connection with the wear of tires and rollers, but perhaps the mill was not operated long enough. The manufacturers of the Marcy roller-mill seem to have effected a compromise; for whereas the feed-end of the mill is supported by a trunnion-bearing, the discharge-end is supported by a tire that revolves upon two rollers. Otherwise the mill seems to be all that can be desired from a mechanical point of view. The reason for having chosen the tire-and-roller support in preference to the bearing support for one end lies undoubtedly in the design of the discharge-end and door, where it would not have been possible to put a trunnion bearing.

The Allis-Chalmers Manufacturing Co. has gone a step further in design; its rod-mill is of a double-trunnion type, but can be supported on rollers when the discharge-end head is removed. From the point of view of rigidity, lower maintenance cost, security, and mechanical efficiency, I do not think that anybody will question the superiority of the bearing-type of support as compared with the tire-and-roller type.

Drag-Classifier. The drag-classifier used, which was built locally, was of ordinary design, with a 35° slope and a chain-speed of 45 ft. per minute. This machine was also a continual source of trouble, expense, and annoyance. Mechanically, it was costly in upkeep, as it needed frequent renewal of links and rakes. Metallurgically, it was inefficient, as it allowed too much coarse material to overflow, and returned too much undersize to the mill. Perhaps the slope, or the speed of the chain, or both, were not right for the classification required; but in any case this type of classifier, though perhaps useful as a dewaterer or as a sand remover, lacks the flexibility of the modern mechanical classifier such as the Dorr, in which, by quick and simple means of adjustment, a wide range of products can be obtained. Even a considerable increase in the dilution of the pulp in the drag-classifier caused only a small change in the separation. The drag consumed 5 hp., as compared with the ¾ hp. necessary for a Dorr classifier of the same capacity.

Both mill and classifier having proved failures, it was decided to erect a 4½-ft. by 16-in. Hardinge ball-mill to operate in closed circuit with a 2-ft. 3 in., Model C, Dorr classifier. Owing to war conditions, it was doubtful when the machinery would arrive in Chile, so it was deemed advisable to continue working with the Ferraris, inefficient as it was, and to have the foundations ready for the new mill. Either mill could be fed from crusher and elevator. Although the 4½-ft. by 16-in. Hardinge mill was satisfactory from a mechanical point of view and always ran 100% of the time, it was unable to do the work demanded of it, which was 40 tons per day from 1½ in. to 80-mesh. The mill was loaded originally with 3500 lb. of chrome-steel balls, of which 1300 lb. was of assorted balls, ranging in size from 2 to 4 in., and 2200 lb. was of 4-in. balls weighing 9.4 lb. each. The maker's catalogue stated that the 4½-ft. mill would take 4200 lb. of balls, but 3500 lb. was all that could be fed. As a rule I have found that ball-mill manufacturers exaggerate the load of balls that their mills will take by as much as 40%. The Hardinge mill and Dorr classifier combination was a great improvement, for both machines worked well, and delivered a uniform and steady feed to the M. S. machine.

The mill, which was run at 34 r.p.m., required 18 hp.; the motor driving it was of 30 hp. The mill ground 20 tons of Caracoles ore per day from 1½ in. to 12% on 80-mesh. Of the classifier overflow, 60% would pass a 200-mesh screen. The moisture in the mill was varied from 20% to 60%; it was found that the best results were obtained with about 30 to 35%. When the ore was soft and clayey, 35% water was desirable; when hard and compact, 30%. If the water was reduced much below 30% the mill would discharge a considerable amount of coarse ore. This was undoubtedly due to the fact that no classifying action took place in the mill when the pulp became too thick and sticky. When the proportion of water in the mill was correct for the particular ore under treatment, and when the feed did not exceed the maximum amount that the mill could efficiently grind, the large pieces of ore were retained in the cylindrical portion of the mill until ground, and the discharged product was fairly uniform in size. If the water was reduced to, say, 20%, the mill would begin to discharge ore that was considerably coarser, even if the rate of feed was not increased. By closing the jaws of the crusher to ¾ in. it was possible to grind 25 tons per day to 12% on 80-mesh.

The experiment was tried of crushing the feed for this mill in the 48-in. vertical Symons disc-crusher at the smelter. On this feed the mill worked better than on a Blake product, and a tonnage of 25 tons per day to 80-mesh could easily be maintained, even by the Chilean operators. However, the increase in capacity of the mill with the final product of the Symons crusher as compared with that of the Blake crusher was not sufficient to offset the greater cost of crushing and transport from smelter to mill, so the change was discontinued. There is no question that the Symons disc machine delivers a better product for a ball-mill than does a crusher of the Blake, Dodge, or gyratory type. Although the amount of oversize remaining on any screen, say, of 1-in. round holes, be the same for both types of machines, the oversize from the disc consists of long, flat, slaty pieces, which can be more easily crushed by a ball of a given weight than can the cubical pieces delivered by a crusher. Although admittedly a Blake crusher and a ball-mill working in closed circuit with a mechanical classifier provides a good combination for the reduction department of a small flotation mill, on account of simplicity of arrangement and low cost of installation, the ball-mill should be of sufficient diameter to crush easily large pieces of ore. The Blake crusher should be also of sufficient capacity to give a large reduction range, in order that the mill may be fed with the finest product possible. If a small-diameter mill, such as 4½ or 5 ft., is fed with coarse ore, 2-in. cubes for instance, its capacity will be

reduced greatly, even though large balls be used. This will result in low grinding efficiency. After a time only 5½-in. steel balls, weighing 26 lb. each, were fed to the Hardinge mill, but no appreciable gain in capacity was noticed, although less oversize was discharged. This seemed to prove that a greater ball-load will not compensate for insufficiency in diameter. The discharge of such accidental oversize, containing pieces of ore up to 1 in., was a nuisance, for it reached the Dorr classifier; but it speaks well for the rugged construction of the classifier that no part either broke or bent. Mr. Dowsett's method of preventing the discharge of such oversize (a spray pipe with a small nozzle at the end of the mill, placed so that it discharges on the lifting side of the pulp-load and about 18 in. inside the mill) was tried, but no appreciable benefit resulted. The idea was to maintain the consistence of the pulp uniform throughout the mill by feeding the water at both ends. When all the water is added at the feed-end, the pulp at the discharge end is less wet because of an increasing rate of water absorption as the ore is ground. This defect is remedied by adding some of the water at the discharge end, whereby the classifying action of the cone can take place. As the Hardinge mill could not handle the tonnage desired, which was 50 tons per day through 100-mesh, it was decided to order a 5 by 4-ft. Allis-Chalmers granulator, which the makers guaranteed would handle the tonnage.

The preference given to a cylindrical mill calls for an explanation; at first hand it would appear that the change was due to dissatisfaction with the conical mill, but this was not so. The Hardinge mill gave every satisfaction. It always ran 100% of the time, which proves that, from a mechanical point of view, it is well-nigh perfect. It did not grind the ore because it was too small. I am sure there is no mill on the market of an equivalent size that takes the same power and on the same ore could better its performance. The Hardinge mill has the advantage of simplicity of construction and operation. This is a point in its favor not to be lightly disregarded, especially in countries where labor is unskilled. The Chilean operators learned quickly how to work it. In a small plant, where no overhead crane or other facilities are at hand, the simplicity with which a worn-out lining can be removed and a new one substituted is another advantage in favor of the conical will. The mill-manager favored a 6-ft. by 22-in. Hardinge mill, but he was overruled, and a 5 by 4-ft. Allis-Chalmers granulator was ordered.

Pending the arrival of the Allis-Chalmers mill, and in order to run the plant nearer its full capacity, it was decided to operate the Ferraris as a primary mill and the Hardinge as a re-grinder. The original Ferraris was a short cylindrical mill. Its outside dimensions were 5 ft. diameter by 2 ft. 6 in. long. Inside the liners it was 4 ft. 2 in. by 27 in. The lining was of manganese steel, and consisted of long flat plates alternating with short thick lifting-bars. Bars and plates did not fit exactly, so that ore already ground sufficiently fine would discharge through the bottom and between the liners. The ground ore and water would gravitate into the screening compartment, which was divided into a series of pockets by means of a cone projecting into the crushing-compartment and a series of radial partitions extending therefrom. The periphery of the screening-compartment was open, and was surrounded by a screen of the desired mesh. The material not fine enough to go through the screens was elevated by radial partitions; and, sliding back on the surface of the cone, was returned to the crushing-compartment.* This mill was operated at 22 r.p.m. and required 20 hp. (motor input). The lifting-bars gave the balls a considerable lift, greater than in any other ball-mill I have seen, and perhaps too much. The charge consisted of forty 5½-in. balls weighing 26 lb. each, or a total weight of 1040 lb. The mill required an excessive amount of water, at least as measured by present ball-mill practice; otherwise the screens would choke badly. It produced a small amount of slime, and must be an ideal grinder for table concentration. At first, 4-mm. round-hole, punched screens were used. These did not give sufficient capacity, so that 8-mm. screens were substituted. Thus equipped the mill ground 40 tons per day from 1½ in. to 8 mm.

The ground ore from the Ferraris mill was elevated by means of a 10 by 54-in. Frenier pump into the Dorr classifier. It was remarkable that this pump, which is supposed to be a sand-pump, should have been able to handle such a coarse product. Trouble was experienced because chokage occurred at the elbow of the discharge pipe, but by increasing the amount of water this was overcome. This excess of water diluted the pulp over much; too much sand was returned from the Dorr classifier to the Hardinge mill, which choked. Consequently a 5-ft. Callow cone was installed, and the excess water was removed as overflow. The grinding arrangement described was far from ideal, but it enabled the plant to handle 40 tons per day until the Allis-Chalmers mill arrived. It was erected upon the same concrete massif as the Ferraris. It has been in operation for 15 months, and I can compare it with the others. This mill is belt-driven from a 60-hp., 14-amp., 2500-volt induction motor with tramway controller. As the speed of the motor was only 400 r.p.m., no intermediate counter-shaft was required. The driving-pulley was a Type A, friction-clutch pulley made by the same manufacturer. It gave trouble owing to heating, and on this account it was keyed directly to the driving-shaft and used as a plain pulley. Since discarding the clutch-pulley no trouble of any kind has been experienced in starting the mill. The original load consisted of 5600 lb. of forged chrome-steel balls, ranging in size from 2 in. to 4 in., the 4-in. balls greatly predominating. With this load, the driving motor takes 62 hp., and, allowing for the loss in transmission, the mill requires about 50 hp. The feeder is of the combination type, 36 inches in radius, of strong construction, and will handle balls up to 5-in. diameter. It has never choked, in spite of the large amount of sand

*From Richards' 'Ore Dressing'.

from the classifier, at least 250 tons per day. The lining is of manganese steel, and the shell-liners are of the shiplap type.

A peculiar feature of this mill is its variable-discharge diaphragm, by means of which the discharge-level may be regulated and maintained at any point between the periphery and half-way to the centre of the mill, to suit the character of the ore and the ratio of reduction desired. The pulp is discharged through eight rectangular grates or screens, 3 in. thick. These are made of tempered, rectangular tool-steel bars that are set on edge and spaced $\frac{3}{16}$ in. on the inside and $\frac{5}{16}$ in. on the outside, that is, they are tapered to prevent choking. The grates themselves are held in position by wedge-shaped manganese-steel liners, secured by bolts. The intervening spaces between the rectangular grates is filled by triangular-shaped liners that are also held in place by bolts. Behind each grating is a pocket in the face of the diaphragm, to allow the pulp to discharge freely through the grate. The back of this depression is perforated with a number of round holes, thus allowing the pulp to discharge into the spaces between the lifter-arms. With all the holes left open the mill will discharge at the periphery, but by closing the outer holes with wooden plugs the discharge is raised accordingly. If only the two innermost holes are left open, the mill will discharge one-third from the centre, and it will then be almost as full of pulp as the ordinary type of trunnion-overflow mill.

After the mill had been in operation for some time and when its operation was thoroughly understood, tests were made to find out what was the best height of pulp. It was necessary to grind the maximum tonnage possible from 1½-in. feed to 1% on 100-mesh, with the mill working in closed circuit with mechanical classfier. In every instance it was found that the mill worked most efficiently and at its maximum capacity when discharging at the periphery. Our particular case was a problem of fine grinding in one stage; therefore, from theoretical considerations, it would appear that a high level of pulp should have been found more beneficial than a low one. Such was not the case; in our experience in treating four different kinds of ores in this mill the necessity never arose of having to plug up holes to raise the pulp-line. Furthermore, it was found that the regulation of the level of pulp in the mill could be accomplished far more rapidly by altering the density of the pulp. By increasing or diminishing the amount of water, the mill could be made to discharge either at the periphery (water, 35 to 45%), or even through the central pipe (water, 20 to 25%). In the latter case the mill would be full of pulp (choked) like an ordinary overflow mill. This does not mean to imply that the mill was not discharging through the grates, but that by reducing the water in the mill sufficiently the pulp could be retarded as long as desired. Soft Caracoles ore would go through the mill rapidly with 35% moisture, producing a granular product. Under these conditions the raking capacity of the Dorr classifier would be exceeded, and it would either stop or would allow a proportion of coarse material to overflow.

Decreasing the water in the mill to about 30% would remedy this trouble, as the pulp would be retained longer in the mill, and the discharge would, therefore, contain a greater proportion of finished product (minus 100-mesh), which would overflow from the classifier at once, reducing the circulating load to a point where the classifier could handle it. On the other hand, in treating Salado ore, which is a rhyolitic lava with bornite filling the 'steam' cavities, grinding to 48-mesh is sufficient to free the mineral. Further, as the minus 200-mesh material in the tailing carried more copper than any other size, it was desirable to slime as little of the mineral as possible; consequently, the mill was operated with 40% water, which allowed a rapid change of the contents. Therefore, without the necessity of plugging any holes in the diaphragm, widely varying conditions were met by altering the amount of water. This being so, I do not see the need of encumbering the mill with a diaphragm that merely increases weight, reduces length, and is bound to make the mill more expensive. If the advantages of the grate-mill depend—as put forward by advocates—on peripheral discharges, low pulp-line, quick discharge of fine, greater efficiency of ball-load, and non-selective action between mineral and gangue, I do not see the reason for disregarding some of these advantages by artificially raising the height of the pulp. At best the Allis-Chalmers diaphragm seems to me to be a sort of compromise between the overflow mill and the grate-mill.

The capacity of this mill when working in closed circuit with a mechanical classifier was 50 tons per day from 1½ in. to 2 to 5% on 100-mesh of Caracoles ore, and the same tonnage of Salado ore from the same size to 2% on 48-mesh, this ore being harder to grind than the Caracoles ore. The same reduction in capacity as with the other mill was noticed when fed with coarser ore. With the Blake closed only to 2½ in., the tonnage dropped to 42 per day. Therefore the contention of ball-mill manufacturers that the capacity of a mill is only increased to a small amount by feeding it with a smaller feed seems to hold true only in the case of large-diameter such as 8-ft. mills. With the smaller mills the capacity can be increased appreciably, as much as by 25%, by giving the mill a feed such as the largest balls can easily crush. It was found unnecessary to charge the mill with more than 5500 lb. of balls, instead of the 9000 lb. mentioned in the catalogue; the mill worked more efficiently with the smaller load, which was 8 in. below the axis. The experiment was tried of loading the mill to the axis, and it was found that its capacity decreased and the power-consumption increased. It was impossible to deliver the feed into the mill; the ore stayed in the drum of the scoop. The speed of the mill was 25 r.p.m., the power not being sufficient to run at 28. Under the best conditions, the mill crushed as much as 62 tons of Salado ore per day. The consumption of balls was 1.43 lb., and that of liners 0.654 lb., per ton of ore ground.

Life, and Cost per Ton, of Liners for Allis-Chalmers Granulator

Section	Life in tons	Cost, cents per ton (U. S. Cy.)
Throat-liners	6,000	1.00
Diaphragm-wedges	11,820	1.37
End-liners	11,820	1.51
Grates	13,000	1.45
Diaphragm-liners	13,000	1.24
Shell-liners (estimated)	17,000	9.35
Total		15.92

The through-bolts holding the liners in the Allis-Chalmers mill seem to me to be faulty in design; they do not allow the liners to be worn completely, and about one-third to one-quarter of the weight of these expensive manganese- or chrome-steel liners has to be thrown away. (See Fig. 3. The unshaded part is wasted.) A set of throat-liners was weighed when new and when worn out. The amount of the liner that could be used was 61.2% only. With the type of bolt supplied, and as soon as the head wears, the bolts will no longer hold, and the mill will leak badly through the bolt-holes. It is useless to try to tighten the bolts, for, as they lack the square head, they will either turn with the nut or come through the lining altogether. Therefore the semi-worn liner must be replaced, or new bolts must be put in. As the countersunk section of the liner has been worn through, the whole of the square heads of the new bolts protrude inside the mill; here they are knocked about by the balls, and loosen rapidly. An improved type of through-bolt, it seems to me, would be one in the form of a truncated square pyramid as shown in Fig. 4. This type of bolt-head would enable almost all the liners to be worn. The matter is worthy of investigation by mill manufacturers, as ball-mill men cannot but sigh ruefully on seeing so much money go to the waste-heap in times such as these, when a matter of a few cents per ton may make all the difference between profit and loss. A cent saved is a cent earned.

On comparing the actual discharge-areas, one cannot but be struck by the much greater discharge area of the Marcy mill as compared with that of the Allis-Chalmers mill. In the Marcy, the discharge-end is entirely in the form of grates, whereas in the Allis-Chalmers mill there are 16 blind-liners that reduce the area considerably. The actual area of discharge in the Allis-Chalmers 5 by 4-ft. granulator was found to be only 7.7% of the total. I do not know what the actual open space of the Marcy-mill grate is, but it is certainly much greater. The 'chord' arrangement of the Marcy grizzley-bars that make up the eight grate-sections is also superior, in my opinion, to the radial spacing of the grates in the Allis-Chalmers mill; in the former the grate will present a continuous opening to the discharging pulp. Except for the slight defects mentioned, the 5 by 4-ft. Allis-Chalmers granulator gave entire satisfaction, and it was only after it began operating that it was possible to run the mill efficiently, and to give the necessary time and attention to the flotation of the ore.

(To be Concluded)

Talc

*Talc is a hydrated silicate of magnesium. It has a specific gravity about 2.7, is soft, and has a characteristic soapy feel. Ordinary talc is foliated, but the laminæ, though flexible, are not elastic. In color it varies from white, gray-green, apple-green, to dark green. It is not acted upon by ordinary acids and is a poor conductor of heat and electricity. When heated it loses a small amount of water, hardens, and can be polished. The compact fine-grained variety of talc is known as steatite or soapstone. It is usually gray in color and has a crystalline structure. A comparatively impure variety is known as potstone. Much of the talc or steatite of commerce is the mineral pyrophyllite, a hydrated silicate of aluminum; it is somewhat harder than talc, but otherwise closely similar in its physical characteristics. The name agalmatolite is applied loosely to both steatite and pyrophyllite.

Talc is subjected to careful sorting at the mine. Pieces that by their texture and color are deemed suitable for cutting are set aside for subsequent sawing into slabs, from which are manufactured lava-tip gas burners, and tailors' crayons and pencils. A large amount is used in the form of sticks and pencils for marking purposes in iron and steel works. The residue is usually sorted and graded according to the color of the material, but some prefer to sort to one uniform standard, discarding all varieties of color other than that selected. Dressing operations consist of crushing, grinding, and grading. Simple screening is the method generally adopted for grading. Latterly, considerable attention has been given to pneumatic separation, and many separators have been devised to work by this method. Probably 90% of the talc mined is ground to flour and used in the manufacture of paper, molded rubber goods, and foundry facings. Only the highest grades of white talc can be used for toilet preparations such as talcum powder. Very high-grade talc powder is used in medicine. Other important uses for ground talc of good grade are in the manufacture of French chalk and soap, and for lubricating purposes. It is also used as a filler in the manufacture of certain classes of linen and cotton fabrics. Talc has a considerable power of absorption and this property is utilized in bleaching cotton goods and for cleaning silk and other cloths. Much powdered talc is used in the manufacture of waterproof paints, and the fibrous variety is used by manufacturers of gypsum wall plasters. Low-grade ground talc finds a limited application as a polish for glass and leather. Commercial ground talc must be free from impurity. The objectionable minerals are quartz, unaltered amphibole, pyroxene, iron ore, iron pyrite, calcite, and dolomite.

The use of talc, particularly the fibrous variety, as a filler in the manufacture of paper of nearly every grade, is rapidly extending. Soapstone is used for lining stoves and furnaces. Steatite, which is a bad conductor of electricity, is suitable for paneling switchboards.

*Abstracted from a bulletin issued by the Imperial Mineral Resources Bureau, London.

A Christmas Message

By Herbert Hoover, Secretary of Commerce

The economic recovery of Europe is necessarily slow and difficult. It contains great dangers, but it is not at all as gloomy as some statements would make it appear.

Since the Armistice, the combatant states (except Russia) show steady gains in social and political stability; they show great progress in recovery of agriculture, industry, foreign trade, and communications. The one field of continual degeneration is that of governmental finance—that is, the unbalanced budgets, the consequent currency inflation of certain countries with its strain of credit destruction.

The most eminent and most dangerous of these unbalanced inflation situations is that in Germany. Her case depends upon the method and volume of reparation payments. As the United States does not participate either in its control or its receipts we have no voice or right to interfere. In any event this is particularly a European matter and must be adjusted by the parties at interest. It is earnestly to be hoped that the present negotiations upon reparations may succeed in finding a sound basis that will ensure permanent economic and political stability to Germany, and certainty of regular payment to the Allies. With this effected, the way is open for constructive consideration of the situations in other states.

The American people have never been and will not be remiss in participation in these further measures, but our people cannot successfully enter until those who have control of reparations have settled this major issue upon so sound an economic basis that we can look upon the future of Europe with confidence.

Outside of government finance of a limited number of states, the outlook is very encouraging. Any general survey of the social situation in Europe will show that danger of bolshevism is passed, partly through improved standards of life and partly through the salutary lesson of Russia. Democratic institutions are gaining strength among the 150,000,000 people formerly supporting autocracies. In Russia itself extreme communism is slowly boiling to death in a cauldron of starvation and its leaders freely acknowledge failure.

In international political relations, aside from conflict in Turkey, war has ceased and treaties of peace are effective throughout the world. Warring states have settled for a time their major territorial issues, and while there are remote forces of instability, the new boundary alignment is winning acceptance, and agencies for allaying international friction are proving themselves steadily more effective. There are bright prospects of limitation in naval armament. Agreed limitations in land armament are not very hopeful, but the economic pressure of taxes and unbalanced budgets is slowly disarming the countries of Europe, and it will disarm more of them yet. The number of men under arms has decreased by fully a million in 12 months.

In the field of economic life, the progress of agricultural and industrial production since the War is very marked. Famine has disappeared from Europe save in Russia. Except in countries where credit machinery is checked by danger of fiscal bankruptcy, as is the case of Austria, food, fuel, and clothing supplies are sufficient, albeit, with a low standard of living in some places; but even in these countries the standards are much higher than the low point after the Armistice. Populations have fairly settled to work and industrial efficiency and productivity are being steadily restored.

Private credit institutions of the world are demonstrating their ability to handle the international trade and credits, except for those regions excessively disabled by the currency demoralization.

Transportation and communication have been reconstructed. There are some useless hindrances to freedom of healing processes of commerce through artificial barriers between the new nations, but by and large the processes of healing are going on.

ACCORDING to estimates compiled by the U. S. Geological Survey in 1908 and reviewed by the Department of Agriculture in 1916, the water-power resources of the State of Washington amount to 125 hp. per square mile, or a total of over 8,500,000 hp., states a Washington Geological Survey bulletin. This gives Washington first place in water-power resources in the United States. Oregon ranks second with 68.4 hp. per square mile, and Idaho third with 60.4 hp. per square mile. The present water-power development of the State totals 408,987 hp., which is only a small fraction of the available resources. The mines are situated in the mountainous areas in the northern part of the State, so power problems for the most part are reasonably simple. Several of the companies are so situated that they can take advantage of local power resources and thus furnish the mine and mill with water-power at a low cost. The Sunset copper mine at Index and the Boundary Red Mountain mine of the Mt. Baker district form typical examples of such an installation. The majority of the mining districts are served with electric power generated by nearby power-plants. In the Oroville-Nighthawk district, the Okanogan Valley Power & Light Co. is increasing the capacity of its plant to 2500 hp. and expects to sell power on mining contracts at $50 per horse-power-year. The Metaline mining district is well supplied with power from the large installation of the Inland Portland Cement Co. In Stevens county the magnesite and metal-mining industries are supplied with power from the Meyers Falls plant of the Stevens County Power & Light Co., and from the Long Lake plant of the Washington Water Power Co., which has completed a 40-mile pole line into the Chewelah district during 1920. The Northport smelter receives power from Bonnington Falls, British Columbia.

OF the 9084 bona fide resident students enrolled in the University of Illinois, 1892 undergraduates have registered in the college of engineering. Mechanical and electrical engineering each attract 420. Only 86 are studying mining.

Historical Sketch of Ore Treatment in Colorado

By Horace F. Lunt

INTRODUCTION. The first mining in Colorado, as in other Western States, consisted in working the gold placers. These were first worked by hand with pan, cradle, and small sluices. The gold veins, which were the sources of the placer gold, were soon located and silver deposits were discovered not long afterward. At first the precious metals were the only ones considered; copper and lead were regarded merely as necessary by-products to provide the means for the recovery of the gold and silver; zinc was highly detrimental, and, if the ore contained more than a small percentage, it was left in the ground or thrown over the dump. Rich ores were plentiful, skilled metallurgists were few, costs were excessive, much high-grade ore and most smelter products were shipped abroad for refining. Ores that were not amenable to the simple processes in vogue were passed by until a later day. Crude and simple smelting and milling methods were adapted or evolved, and have been gradually improved as the necessity for treating lower-grade and more complex ores has arisen and technical knowledge has increased.

The high cost of smelting in the early days encouraged the development of concentration and stimulated the milling of low-grade ores by various reduction processes. Special problems connected with the reduction of particular ores were met and solved by methods and devices adapted to the needs of the moment. Many of the Colorado metallurgical inventions were of transient value, or of use only under local conditions; others have proved of general application and of world-wide significance.

The first smelters were placed close to the mines. As railroads were built, the better transportation facilities made it practicable to concentrate the smelting industry at central points, such as Denver, Durango, and Pueblo, where ores from different districts could be obtained and more advantageous smelting mixtures used. The mining-camp smelters were abandoned, one after the other, until only the one at Leadville, which happens to be centrally situated, remains.

As time went on, the base metals became more and more important, until, in 1918, the value of the zinc produced in the State exceeded that of silver. Ores of rare metals, such as tungsten, vanadium, uranium, radium, and molybdenum, utterly unheard of by the pioneers, were discovered and came to have a commercial value. At first they were shipped abroad, but methods for their reduction were worked out and plants for treating them erected in the State.

SMELTING. The first smelter in Colorado was built at Nevadaville, in Gilpin county, by Caleb S. Burdsall in 1862. It burned down before it had really started to operate.[1] Another small plant was erected at the same place in 1866, but met with no success. The first successful smelter was built at Blackhawk, in the same county, and started operations in January 1868.[2] At this time the gold mines, which had been discovered about ten years before, had been worked down below the easily treated outcrops, and the simple amalgamation methods of the pioneer millmen could no longer make a satisfactory saving. Various quack processes were tried without avail, and the miners were beginning to abandon their claims in the belief that they were of no further value.[3] Nathaniel P. Hill, who had been a professor of chemistry in Brown university, visited Gilpin county in 1866 and was convinced that the ore could be smelted. He went back to Boston and organized the Boston & Colorado Smelting Co. to build the plant above-mentioned. Herman Beeger, who has been called the father of smelting in the West, was the metallurgist in charge. It consisted of two small reverberatory furnaces, one of which was used for calcining and the other for smelting the calcined ore to a copper matte containing the gold and silver.[4] This matte was shipped to Swansea, Wales, for refining.[5] Later on it was treated in Boston. In 1873 Richard Pearce, who had become associated with Hill in the management of the smelter, invented a process for refining the product, which made it unnecessary to ship anything but bullion. The plant was successful from the start; it was enlarged, and the company built a branch smelter at Alma in 1873. In 1878 the business was moved to Argo, near Denver, where it was continued until 1910, when the dwindling supply of copper ores and the competition of the lead smelters caused it to be shut-down. Other copper smelters had never had any permanent success and had ceased operations previously.

The most noteworthy detail of the operations at the Boston & Colorado smelter was the Pearce process, for many years kept secret, of extracting gold from copper bottoms. In brief, this depended on the fact that when the copper, containing gold, was heated with pyrite, under proper conditions, one atom of the sulphur combined with the copper, forming a matte, and leaving the gold in metallic form.[6]

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[1]Bastin, E. S., Henderson, C. W., and Hill, J. M., 'Ore Treatment, etc.: Economic Geology of Gilpin, Clear Creek, and Boulder counties, Colorado', U. S. G. S. Prof. Paper 94; p. 153.

[2]Bastin, Henderson, and Hill. Op. cit.; p. 154.

[3]Raymond, R. W., 'Statistics of mines and mining in the States and Territories west of the Rocky Mountains', 1869; pp. 347-348, 1870.

[4]Bastin, Henderson, and Hill. Op. cit.; p. 154.

[5]Richard Pearce, 'Progress of metallurgical science in the West', Trans. A. I. M. E., Vol. 18, p. 56, 1890.

[6]Pearce, H. V., 'The Pearce gold-separation process', Trans. A. I. M. E., Vol. 39, p. 722, 1908.

During the 'seventies smelters were built and operated with varying success in many different parts of the State. Golden became a prominent smelting centre.[7] The first smelter, subsequently known as the Golden Smelting Co. works, was erected in 1872, but was not immediately successful. The French smelting works was built in 1878 and the Valley smelting works in 1879. The Golden Malachite Co. built a plant in 1878 at which, for a time, acid was manufactured from Gilpin county ores.

A smelter was built by the Boston Mining Co. at St. John, near Montezuma, in 1870, in which a lead silicate was made from the rich silver-lead ores of the district.[8] This was re-treated at Empire in a little plant that was erected by John Cullom. Cullom's plant was a failure until H. A. Vezin took charge of it in 1872. Richard Pearce's first experience in Colorado was at Empire. His lack of success there was soon lost sight of in his brilliant achievement after he became associated with the Boston & Colorado company at Blackhawk. Anton Eilers, afterward prominently identified with smelting at Leadville and later a director of the American Smelting & Refining Co., was in charge at St. John in 1875. He was succeeded by Franz Fohr, who also became prominent at Leadville.

In the early 'seventies a negro named Bowman, who had learned smelting in Mexico, operated a small Scotch hearth near Georgetown. He reduced rich galena with charcoal and cupelled the resulting lead in the same furnace. Air pressure was obtained from a huge bellows actuated at first by man-power and later by a water-wheel.[9]

The first smelter at Silverton was built in 1874 by Judge Green, of Cedar Rapids, Iowa. The furnace was built of sandstone with no lining. The machinery for the plant was packed in from Colorado Springs, 300 miles away. The first water-jacket in the State was used at this plant in 1876. The year before John A. Porter had introduced the siphon-tap, but one of these had previously been used at the Swansea plant near Denver.

Among the other early smelters in the San Juan country was the Grand View at Rico, built in 1879, with which F. M. Endlich, Hofman, and Arnold were associated. The San Juan Smelting & Reduction Co. built the first smelter at Durango in 1880. Ore from the first mines in San Miguel county was packed to Silverton or Rico, for the most part, but there was a smelter at Ames in the early 'eighties.

A smelter was built at Dudley, near Alma, in Park county, in 1872, at which E. D. Peters obtained some of the experience that made him one of the leading copper metallurgists of the country. The Gooding smelter at Lincoln, in Summit county, was built in 1878, and a lead smelter at Breckenridge in 1880. The Pittsburg smelter at Kokomo and a smelter at Red Cliff were built in 1879. Riggins and Chapman, two successful lead-smelter-men from Joplin, Missouri, in 1876, brought machinery for a plant at Alpine, on Chalk creek above Buena Vista, to treat the ore from the Mary Murphy mine. Mather and Geist started the first smelter at Pueblo in 1874.

The first two smelters at Leadville were built near Malta, in 1875 and 1876, to treat rich galena ores from the vicinity of Homestake Peak on the other side of the Continental divide.[10] This was before the discovery of the lead-carbonate ores, rich in silver, that made Leadville famous a year or two later. Neither of these plants was operated long. In 1878 and 1879, after the silver discoveries, lead smelting began in earnest and 14 other smelters were built in and around Leadville. Of these, the Harrison reduction works and the Grant smelter, both opened in 1878, were, in the early days, the largest. The Billings & Eilers smelter, between Leadville and Malta, was started the following year and developed later into the Arkansas Valley plant of the American Smelting & Refining Company.

A. R. Meyer, who was in Colorado as ore-buyer for the St. Louis Smelting & Refining Co., shipped over 200 tons of Leadville ore to St. Louis. It had to be hauled in wagons to Colorado Springs, then the nearest railroad point. The ore ran 7 oz. silver per ton and 60% lead. Meyer's company built the Harrison reduction works in consequence of this test. The Grant smelter was built by James B. Grant, who subsequently became Governor of the State. The first use of cloth bags for catching smelter-fume was at this plant, where it was known as the Bartlett dust-catcher. The Grant smelter at Leadville was burned down, and, in 1882, the Grant smelter at Denver was built by its owners.

Guyard gives complete data regarding the operation of the seven Leadville smelters that were running in 1880. The fuel used was a mixture of charcoal, which was burned in the vicinity and cost $18.50 per ton, and coke, which was obtained from Como or El Moro at a cost of $25 or $30 per ton. The proportion of charcoal to coke varied at the different plants from 0.4:1 to 2.4:1. The fluxes were dolomite and hematite from local sources. In the average charge 12.5 parts of dolomite, 6.51 parts of hematite, and 31.99 parts of fuel were used to 100 parts of ore; 19.94 parts of bullion, assaying 250 to 450 oz. silver per ton, were extracted from 100 parts of ore charged. The saving of silver was 96.5% and of lead 88%.

The Globe smelter was built at Denver in 1886, and the Philadelphia at Pueblo in 1888. The Ohio & Colorado smelter at Salida was built in 1900. The American Smelting & Refining Co. was formed in 1889 and included two smelters at Pueblo, two at Denver, one at Durango, and one at Leadville.[11] The only lead smelters now operating in the State are controlled by this company; they are the Durango and Arkansas Valley plants.

The first zinc smelter in Colorado was built by F. L. Bartlett at Canon City in 1890. The process used was de-

[7]Fossett, F., Colorado, p. 234, 1880.
[8]Fossett, F., Op. cit.; p. 491.
[9]Leonard, W. D., Private communication.
[10]Guyard, A., Appendix C to 'Geology and mining industry of Leadville, Colo.', Monograph 12, U. S. G. S., 1886.
[11]Stone, W. F., 'History of Colorado', Vol. 1, p. 315, 1918.

vised to utilize the zinc and lead as well as the gold, silver, and copper. The ore was crushed and treated in a 'blowing-up' furnace with fine coal, whereby the lead and most of the zinc and sulphur were driven off, whereas the gold, silver, and copper were left in a matte. This matte was treated with suitable ores and fluxes in an inclined low blast-furnace and the zinc driven off as fume, leaving a high-grade matte. The fume from both furnaces was caught in bags, refined to remove impurities, and sold as white paint pigment.[12]

Subsequently zinc smelters were built at Florence and Pueblo, and zinc-oxide plants at Canon City and Leadville.

MILLING. The first mills in Colorado were erected in Gilpin county as soon as the soft outcrops were mined out and the need for crushing the ore arose. Various crude devices were constructed. The first arrastra was built in July 1859. A home-made stamp-mill with six wooden stamps shod with iron was built in the same summer. Later in the year the first imported plant, a little three-stamp mill, was erected. Other stamp-mills followed until there were 60 of them in operation by the middle of the following year. The extraction from the highly oxidized surface ores was about 75% of the gold. When the sulphides were reached, this fell to 30%.[13] As a result, production rapidly fell off until the establishment of the Blackhawk smelter created a market for the ore.

The absence of railroad transportation and the distance that the product had to be shipped made the smelting charges very high at this period. This induced efforts to treat the lower grades of ore that could not be profitably smelted. These efforts resulted in the development of the Gilpin county stamp-mill practice, by which a large part of the gold was amalgamated and, later on, part of the valuable sulphides concentrated and smelted. In California, where stamp-mills were first extensively used in this country, the gold was easily amalgamated and the stamps were used simply to crush the ore so that the gold could be caught on the amalgamated table over which it flowed after leaving the mortar. The gold in the Gilpin county ores was not so easily saved; it had to be brought into more intimate contact with the mercury. This was accomplished by making the stamp-mill mortars deeper and larger, with finer screens over the openings; the stamps were lighter and dropped fewer times per minute. The mortars were thereby made amalgamators as well as crushers; the ore was kept in them and churned around with the mercury for a considerable length of time before it could get out. The gold that could not be thus amalgamated remained in the iron and copper sulphides which were recovered, in part, on concentrating tables.[14]

A distinctive form of concentrator, known as the Gilpin county bumping table, was developed. This consisted of a table with a sloping metal surface about 7 ft. long and 18 in. wide over which the pulp flowed. A cam forced the table toward the lower end against a spring, 120 to 180 times per minute, and then released it so that the spring could force it back suddenly against a block at the upper end. This agitation caused the heavier particles of ore to settle to the bottom and be carried up and off the upper end of the table, while the water washed the lighter particles, the gangue, off the lower end.[15]

Gilpin county mills never saved a high percentage of the gold content of the ore. Many devices for recovering the gold in the tailing were invented and tried without success. The local practice, as described above, is a thing of the past. In the few mills that are still running, amalgamation has been discarded in most cases and modern methods of concentration are used.

The free-gold ores of Summit and Park counties, and other parts of the State where gold was discovered prior to 1890, were easier to treat than those of Gilpin county. At first, satisfactory results were obtained by stamp-milling and amalgamation. The practice of concentrating the tailing to save part of the valuable contents of the ore that was not amenable to amalgamation was soon generally adopted and became standard practice. After the discovery of the cyanide process many mills, especially in the San Juan country, were equipped to cyanide the tailing. Many dumps, where the comparatively high-grade tailings from early operations had been saved, were cyanided successfully. More recently, the flotation process has so improved the results that can be obtained, in most cases, by concentration alone that both amalgamation and cyanidation have been discarded in its favor.

The discovery, in 1891, of the telluride ores of gold at Cripple Creek, introduced entirely new metallurgical problems. Stamp-milling and amalgamation was tried first on the ores that were not rich enough to ship to the smelters at Denver and Pueblo. Ten mills, with an aggregate of 270 stamps, were built during 1892 and 1893, but, even with the addition of percussion tables and blankets, the saving was bad. The free gold would not amalgamate satisfactorily, owing to a tarnish supposed to be tellurite of iron. As depth was attained and unoxidized ore appeared, the extraction became worse and the method was abandoned.[16]

The first chlorination plant was built by Edward Holden in 1893, but the first well-designed mill to use this process was not completed until January 1895. It was situated at Gillett. Experiments were being made contemporaneously with cyanidation, and there was great rivalry between the advocates of the two processes. Until about 1910, chlorination was the more successful; then the improvements in cyanidation gave the latter process the advantage.

[12]Bartlett, F. L., 'The Treatment of Zinc-Lead Sulphide Ores', in 'The Mineral Industry', Vol. 5, p. 619, 1897.

[13]Bastin, Hill, and Henderson. Op. cit.; p. 153.

[14]Rogers, A. N., 'The mines and mills of Gilpin county, Colorado', Trans. A. I. M. E., Vol. 11, p. 29, 1883.

Rickard, T. A., 'The Stamp-Milling of Gold Ores', Chap. 2, 1898.

[15]Richards, R. H., 'Ore Dressing', Vol. 2, p. 680, 1903.

[16]Rickard, T. A., 'The Cripple Creek Gold-Field', Trans. I. M. & M., Vol. 8, London, 1899.

Lindgren, W., and Ransome, F. L., 'Geology and gold deposits of the Cripple Creek district, Colorado', U. S. G. S., Prof. Paper No. 54, p. 138, 1906.

The barrel-chlorination process, as used in the various mills treating Cripple Creek ore, consisted in crushing dry to about 20-mesh, roasting in mechanical roasters to about 1600°F., and treating with electrically generated chlorine in barrels. The tailings from the chlorination barrels were treated on Wilfley tables, the concentrate, representing about 0.04 of the pulp, being sent to the smelters. The solution, filtered from the pulp in the barrels, went to vats in which the gold was precipitated by hydrogen sulphide.[17]

The chlorination mills in the district and at Florence were closed one after the other, and the reduction of the Cripple Creek ores became centred in three mills at Colorado Springs. The United States Reduction & Refining Co. had two plants there, namely, the Philadelphia, built in 1896 and closed in 1904, and the Standard, built in 1901 and closed in 1910. The rotary-scoop feeder, now almost universally employed on tube and ball-mills, was invented and first used at the Standard mill. The Telluride mill was built as a bromination plant in 1899; it was changed to chlorination in 1904, and closed in 1906. In 1908 it was purchased by the Golden Cycle company and re-opened as a cyanide mill. It is the only plant at Colorado Springs still in operation. The Portland Gold Mining Co. built a chlorination plant at Colorado Springs in 1902; it was changed to cyanidation in 1912 and closed in 1918.

The Portland company introduced fine grinding in cyanide solution, without roasting; agitation; and zinc-dust precipitation in its Victor mill, built at the mine in 1910. The Independence mill of the same company, also situated near the mine, embodying many improvements, was opened in 1917 and is still in successful operation. The Victor mill was closed in 1918. Several innovations have been worked out at these mills, the most important of which is the Crowe vacuum-precipitation process, which has been adopted in many other cyanide plants.[18]

Silver ores, which were discovered in the 'sixties in Clear Creek, Boulder, and Summit counties, were by no means as easily reduced as the gold ores. Early attempts at lead-smelting were not successful and soon gave place to reduction mills in which the silver was recovered, after the ore had been given a chloridizing roast, by leaching in a sodium hyposulphite solution or by pan amalgamation.

These plants treated second-class ores, that is, those carrying less than 200 oz. silver and not much lead. The remaining ores were shipped to smelters, either in Colorado or in Germany, England, or the East.[19]

The success of lead smelting, following the development of the Leadville lead-silver ores, caused the abandonment of these mills, as they saved none of the lead and a smaller percentage of the silver, with a greater operating cost, than the smelters. While the higher-grade ores could be shipped direct to the smelters, the necessity for concentration soon became apparent, and mills for this purpose were erected.

During the early 'seventies, there were several chloridizing mills in successful operation in Clear Creek and Boulder counties, and the process was improved in many ways. In the Stewart reduction works at Georgetown, D. W. Brunton, who was chemist and later superintendent, in 1875, substituted calcium hyposulphite, made from the waste gases from the roasters, for sodium hyposulphite, which was then imported from Germany at a great expense. In 1876, while treating the roasted ore with sodium hyposulphite and sodium chloride, Mr. Brunton discovered that the recovery of silver was improved when there was zinc in the ore. A few experiments showed that the zinc chloride was an effective solvent of silver. The ore was roasted so as to produce a maximum of zinc chloride while chloridizing the silver, utilizing the zinc chloride as a solvent and recovering the silver by precipitating it in metallic form on copper plates. This was undoubtedly the first commercial use of zinc in Colorado, but as the zinc could not be sold, it was run to waste after performing its function as a solvent.[20]

The oxidized silver ores of Custer county were amenable to pan amalgamation without preliminary roasting and were so treated at Rosita and Silver Cliff.[21]

Most of the surface ores of Leadville and other places that subsequently became zinc producers contained very little zinc. As depth was attained and zinky ores were encountered, efforts were made to get rid of the zinc minerals and make a clean lead concentrate that would not be penalized by the smelters. This resulted in many improvements in ore dressing. In 1885, while manager of the Colonel Sellers mine at Leadville, D. W. Brunton erected what was probably the first plant to separate galena and blende. The latter had no commercial value but, with unusual forethought, was stored in large log cribs and sold many years later. The success of the Colonel Sellers plant instigated Meyer Guggenheim, who owned the adjoining A. Y. & Minnie mine, to engage Mr. Brunton to erect a similar plant on that property.

The Wilfley table was invented by Arthur R. Wilfley, and first used by him in a mill at Kokomo, in 1896, where he was trying to effect the separation into marketable products of one of the complex sulphide ores for which that district is noted. F. L. Bartlett at Canon City, S. I. Hallett at Aspen, and probably others, were working contemporaneously and independently along similar lines, but their tables were not as successful as the Wilfley. The Wilfley table has revolutionized ore dressing and was the forerunner of all modern shaking tables with longitudinal riffles.[22] It is unquestionably the most important invention ever made in Colorado in connection with the treatment of ores.

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[17]Lindgren and Ransome, Op. cit.

[18]Crowe, T. B., 'Effect of oxygen on precipitation of metals from cyanide solutions', Trans. A. I. M. & M. E., Vol. 60, p. 111, 1919.

[19]Raymond, R. W., 'Statistics of mines and mining in the States and Territories west of the Rocky Mountains', 1872, Chap. 7, 1873.

[20]Brunton, D. W., Private communication.

Rickard, T. A., 'David W. Brunton, Consulting Engineer', 'M. & S. P.', Vol. 122, p. 746, May 28, 1921.

[21]Fossett, F., Op cit.; pp. 472-473.

[22]Richards, R. H., 'Ore Dressing', Vol. 3, p. 1465, 1909.

LONE RANCH, CURRY COUNTY, OREGON. OLD BORATE DEPOSITS SHOW AS WHITE SCARS IN THE FOREGROUND

Priceite, the Borate Mineral in Curry County, Oregon

By Hoyt Stoddard Gale

PRICEITE, a hydrous calcium borate, has been reported from only one locality in the United States—on the Lone ranch, in Curry county, Oregon. Specimens brought from this locality were presented to the California Academy of Science in 1872; and, after study had proved its identity as a new mineral, it was named priceite, in honor of Thomas Price, a well-known metallurgist of San Francisco.

Priceite is represented by the formula $5CaO{\cdot}6B_2O_3{\cdot}9H_2O$, thus having the following theoretical composition:

Boron trioxide, B_2O_3	48.7
Lime, CaO	32.5
Water, H_2O	18.8
	100.0

The mineral from Oregon is generally described as friable, chalky, and very soft, and as occurring in roundish lumps that are remarkably homogeneous and of a pure milky-white color; it is said that it is firm and compact when first taken from the ground, but that it soon softens on exposure to the air. The mineral and its deposit have been described in the literature as follows:

Chase, A. W., 'On the Oregon Borate of Lime', Am. Jour. Sci., 3rd ser., Vol. 5, pp. 287-290, 1873.

Silliman, B., 'Mineralogical Notes on Utah, California, and Nevada, with a Description of Priceite, a New Borate of Lime', Am. Jour. Sci., 3rd ser., Vol. 6, pp. 128-133, 1873.

Whitfield, J. E., 'Analyses of Natural Borates and Borosilicates', U. S. G. S. Bull. 55, pp. 56-59, 1889.

Larsen, E. S., 'Proof that Priceite is a Distinct Mineral Species', Amer. Mineralogist, Vol. 2, pp. 1-3, Jan. 1917.

Priceite is so fine-grained that only under the microscope is it seen to be a completely crystalline mineral (crypto-crystalline), an aggregation of crystals of microscopic fineness. The crystals are minute rhombic plates of the triclinic system; in this feature priceite is distinct from colemanite, which it closely resembles in composition, as colemanite is monoclinic. Silliman named the mineral priceite in his paper published in 1873, and Vom Rath gave the name pandermite to an identical mineral from Asia Minor in a paper published in 1877. The identity of priceite and pandermite is proved by the optical evidence, as has been demonstrated by Larsen in the paper cited. The mineral from Asia Minor is one of the important commercial sources of borax, and is commonly referred to in the trade as boracite, a usage which is totally unwarranted, for boracite is an accepted name for an entirely distinct mineral. Priceite somewhat resembles the weather-softened boro-silicate mineral 'howlite', found in the Calico borate district of California, and elsewhere; the term 'pandermite' has long been in local use in California to designate howlite, a usage that is, of course, incorrect. Thus much that is called pandermite is neither pandermite nor priceite, and by right of priority the term priceite should be applied to the original pandermite.

GEOLOGIC RELATIONS. The deposit of priceite in Curry county, Oregon, lies in the margin of one of the great areas of serpentine that are extensively distributed in this part of the country. The mineral was first exposed in the caved bluff overhanging Cresswell creek, so that its discovery may be considered accidental, because normally it is unlikely to crop out at the surface or to remain long exposed to the weather. The exposures at present are obscured by the soft and sliding ground that

is characteristic of broken serpentine rock. This makes mining difficult.

The sea-coast at this place shows the usual upper benches that are supposed to represent former beaches, now raised above water-level, such as are common along the Pacific coast of North and South America. The topography of the country is rugged, and the surface is intricately divided by streams. The shore is generally precipitous, with broad areas of jutting rocky headlands and intervening stretches of sandy beach. The rainfall has averaged about 80 inches per annum, and for much of the time the coast is bathed in fog. As a consequence, the ground must usually be thoroughly water-soaked, and it would not be natural to look for deposits of water-soluble minerals or readily disintegrated materials within easy reach of the surficial water. The most significant feature of the topography, in relation to the priceite deposit, is that the whole coastal slope about the deposit is a jumble of slides or slumps. This condition is shown by the general aspect of the surface; and the surface evidence is corroborated by statements of the miners who worked on the deposit underground. Slumping is a common feature in broken serpentinous rock, which in the wet disintegrates to a talc-like slippery soil, that in fact is made up of talc or related magnesian compounds. Materials that are formed in this way from the alteration of basic igneous rocks are called soapstone or steatite because of their resemblance to soap.

The occurrence of a calcium borate in serpentine is apparently unique, and so this deposit is distinctly different in mode of occurrence from the colemanite deposits of California and Nevada. There is little correspondence between the geologic relations of the Oregon priceite and those of the so-called pandermite found in Asia Minor, for the latter is described as occurring in the form of nodules embedded within a sedimentary deposit of gypsum. However, the mineral in both places may be considered to be a deposit from springs or groundwater, and to that extent of the same origin in spite of the fact that the surrounding rock is different.

Little can be ascertained as to the manner in which priceite occurs by examination of the surface, or without fresh excavations; so that we are fortunate in having several lucid and satisfactory accounts and descriptions of the mineral by those who were present at the time mining was in progress. For a particularly clear and interesting account I am indebted to Winfield Duley, who was one of the workers on the deposit in the early 'nineties. The several accounts agree on essential details. The priceite as found in place occurred principally in roundish boulder-like masses of various sizes, ranging from minute grains to a maximum recorded lump that weighed 46 tons. Each lump was perfectly homogeneous, without a perceptible particle of grit or foreign matter. The mineral was compact and firm when first taken out, but rapidly softened on exposure to the weather; hence it has always been described as soft, powdery, and incoherent. It was invariably pure milk-white in color, and resembled chalk.

The lumps of priceite were scattered in a black clay matrix, many of them in continuous lines or a system of intersecting lines. The miners dug under each lump until it dropped away from its clay matrix, leaving a cavity with dense polished black inner surface. The clay immediately around a priceite lump was so much denser than that of the deposit generally that the miner could tell by the feeling of his pick when he was approaching one of the lumps. Mr. Duley is certain that the priceite boulders have formed in place, partly because of the way the clay is compacted about the lumps, as if it had been squeezed aside. Besides, he says, each lump of priceite has a feeder in the form of a trickle of water in the back of the cavity or socket. Some of the lumps found in continuous rows stood upright like a set of horse's teeth of immense size. The lumps separated clean from the clay matrix and were easy to mine; though fairly hard when taken out, they readily broke when struck with the point of a pick.

Lieutenant Chase, in the paper cited above, gives a similar description derived from experience in the earlier mining that was done on the deposit about 1871 or 1872, when the mineral was supposed to be valuable chiefly for use as polishing powder. He says: "In cutting away the bank above the spot where the first outcrop appeared, several layers or strata were met with, of varying thickness. The first in order was a soft green clay or decomposed talc, with streaks and globules of a white waxy substance, itself another form of steatite. The second, a layer of black slate or rock broken into a thousand fragments and resembling coal. Then a layer of slate seamed with white veins and masses of decomposed talc. These layers did not contain any traces of boric acid. Then came a layer of white and hard borate, filling the seams and cavities of the slate, and pressing down on a layer beneath, which was a tough blue steatite with green and white veins, and of the consistence of clay. Wherever a hollow had been formed in the blue steatite, the hard borate pressed down into it and formed a hemisphere, the upper parts being mixed with slate, the lower pure. In the blue steatite, and a few inches below the slates, the main bed or flow was found. Here the borate was in the form of boulders or rounded masses, completely embedded in the steatite, and in shape not unlike a pumpkin or squash, the sides being corrugated and having little depressions in the top surface. These boulders formed a continuous line, and were of uniform size in the main flow, weighing about 200 lb. each, although some were much larger, one weighing 450 lb. Branching off from the main deposit were side flows, where the boulders ran from 20 lb. down to small pellets the size of a pea and even smaller."

It appears from these descriptions that priceite follows the habit of a number of other borate minerals, that is, it grows in the form of lumps within an enclosing matrix. This is certainly the habit of ulexite and seems to be that of colemanite, as well as of priceite and boracite. The mode of occurrence of priceite shows that it may have separated from, or grown by reaction with, perco-

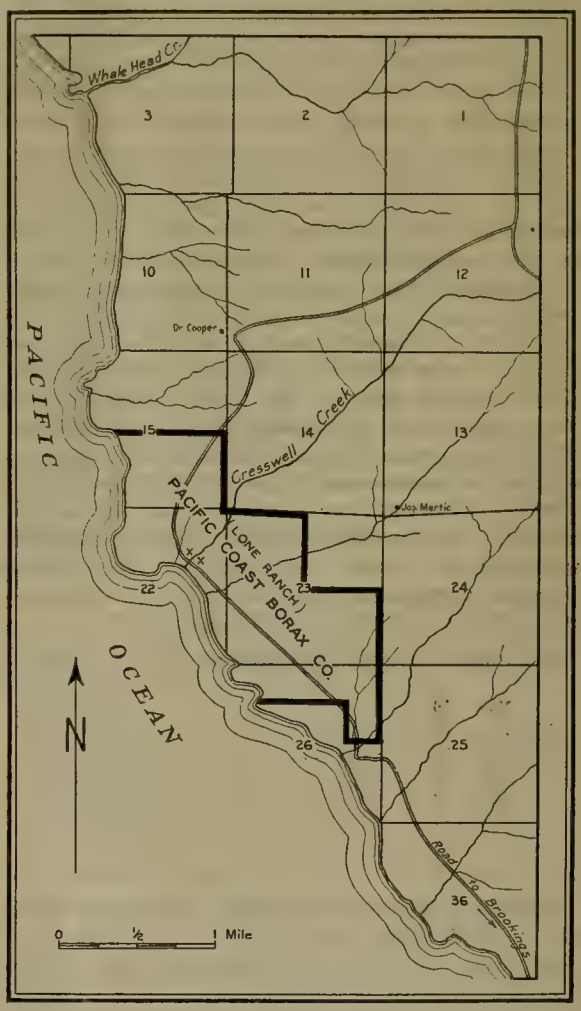
lating ground-water. It may be assumed that the ground-water carried the boron required, probably in the form of boric acid, and that this acid reacted with an available base. There is no apparent reason why the borate mineral should have formed only at this particular locality in Curry county, for similar country-rock is distributed over wide areas in this region; and there is no distinctive evidence of spring action on the Lone ranch that could not be duplicated at almost any other point in the vicinity. Van't Hoff found that sodium-chloride solutions have an influence in facilitating the separation of some of the calcium borate minerals, and there is a bare possibility that the spray of sea-water may have exerted some influence at this locality, but this suggestion is no more than a guess. There seems to be little to offer in the way of an explanation of the origin beyond the clues given in Duley's statements, until the deposit is reopened and an opportunity for further observation afforded.

Locality of the Deposit. The Oregon deposit of priceite was found on a homestead property that is still known as the Lone ranch, in sections 15, 22, 23, and 26, T. 40 S., R. 14 W., Willamette meridian, as shown by the accompanying plat of the township. The deposit itself lies in the bluffs and lower hill-slopes at the mouth of Cresswell creek, only a few hundred yards from the sea. Cresswell creek and another similar stream a quarter of a mile south enter the ocean in a little cove that lies between two rocky headlands as shown in the half-tone. The old mine-dumps near the ranch-building are now largely obscured. The mine-buildings and the old warehouse that was used for the shipment of the borate are gone.

The locality is most conveniently reached by road up the coast from Crescent City, in northern California, to Brookings, Oregon, over a main route of automobile travel, a distance of about 30 miles. From Brookings it is necessary to follow the road that runs nearest to the coast, which is rather rough, crossing the ridge-points a short distance back from the shore; by this road it is about five miles to the mouth of Cresswell creek and the old mine-workings. Crescent City may be reached by automobile-stage either from Eureka, California, or from Grants Pass, Oregon.

History of the Property. The Lone ranch is said to have been homesteaded early in the 'sixties by John Cresswell, or by a predecessor from whom the property soon passed into Cresswell's possession. The tract now known by that name comprises about 1050 acres, and stands in the name of the Pacific Coast Borax Co., a subsidiary of the Borax Consolidated, Ltd., of London, the English concern that almost controls the borax industry of the world. No attempt has been made to work the deposit since 1892, the property being let at a nominal rental for sheep raising to a man who also acts as caretaker. The history of the discovery of borate on this property and of the manner in which the early work was done is a record of significance both as to the mineral character of the deposit and its economic value.

Lieutenant Chase states that farmer Cresswell's attention was early called to an outcrop of a white substance, which he called chalk, on the banks of the stream that entered the sea from his property, where he found it in a caving bluff exposed by winter floods. This, he says, was about 500 yards from the sea and 20 feet above it. The 'chalk' was used by the coopers at the fisheries on Rogue river and the carpenters in the neighboring towns. The material also acquired a reputation as an excellent



POSITION OF LONE RANCH DEPOSIT IN OREGON

polishing powder for silver. Study of the mineral in San Francisco about this time proved it to be a borate, and the records of its occurrence were published. Apparently no practical significance was attached to the discovery.

About 1890, Cresswell sold his homestead rights to Denis Tryon for $10,000. In the same year an Englishman named Fleming, who had had some experience with borax, came upon the records of this mineral in San Francisco; and, going to the Lone ranch, obtained an option for the purchase of the property from Tryon, good for six months, for the sum of $25,000. Fleming

then put two men to work to open the deposit, soon finding a considerable body of the mineral. He allowed his option to expire, however, and the property was purchased by Walter W. Gray, acting in behalf of the Pacific Coast Borax Co. Gray then managed the development of the property, employing the miners by day's pay. A number of tunnels were run into the bank on the south side of Cresswell creek, near the locality where the first exposure had been found, but the results seem to have proved not wholly satisfactory, as this mining was referred to later as having been expensive and unprofitable and was not continued long. When the company discontinued work there were a number of miners or prospectors at the property, and they were told that if they could find an unopened portion of the deposit on the property a contract would be made with them to mine and deliver the mineral at a price per ton to be agreed. Several undertook the search, but most of them finally gave it up without success. One man, however, James C. Christensen—'Chris Christensen'—fared better than the rest and dug into a promising body of ore in the hillslope north of Cresswell creek, almost opposite the bank where the other work had been done. In April 1891, Gray, acting as agent for the borax company, entered into a contract with Christensen, agreeing to pay $23 per ton for such ore as he should mine and deliver for shipment at the seashore on the property and specifying a certain tract, about three acres in extent, within which he should be permitted to operate. Work was started soon after the contract was signed, and the following shipment, aggregating about 580 short tons, are recorded as having been paid for under this agreement:

1891	Prior to October (approximately)	30	tons
	Oct. 2	42,088	pounds
	Nov. 30	50,862	"
1892	Jan. 30	90,987	"
	Apr. 18	86,621	"
	May 31	102,516	"
	Aug. 17	182,872	"
	Sept. 26	143,109	"
	Oct. 19	99,450	"
	Nov. 23	300,396	"

Christensen showed by testimony in a suit that during the last 30 days of operation under the contract he had taken out 150 tons of ore at a total cost to him of $1100 for wages and board of the miners, so that he figured his cost of mining at less than $10 per ton. Evidence was given by several of the miners who had worked on the property for Christensen that the ore in sight at the time the work was stopped, within the three-acre tract covered by the contract, was sufficient to have permitted production at about the same rate for two or three years. Thus there is specific evidence available as to the probable reserves in this portion of the deposit.

Other Deposits. This deposit is of interest not mainly because it appears to represent a unique occurrence of borate mineral, but for the suggestion it carries that there may be other deposits of the same type which have perhaps been overlooked. Country-rock similar to that in which the priceite is found in Curry county is widely distributed along the Pacific coast and elsewhere; and, if the borate has any genetic connection with the serpentine rock in which it has been found, other deposits might be discovered by ascertaining the clues by which they should be recognized. If prospectors find white chalky deposits in places similar to that described above they should have their specimens tested for borate, in the hope that valuable deposits of this substance may be found.

The annual world production of tin prior to the War was from 120,000 to 125,000 tons, and, as far as can be gathered, the average annual production for the three years ended 1916 was 123,000 tons, of which the British Empire produced 54.5%, states the Chamber of Commerce Journal in quoting from an article in the Bulletin of Indian Industries and Labor. The Federated Malay States furnished the largest contribution both to the Empire and to the world's supply; in 1918 the output amounted to 37,370 tons. For the same year it is estimated that Burma turned out ore containing at least 1261 tons of metallic tin. The imports of tin into India during 1918 were 1229 tons. This shows, says the Journal, that Burma is capable of producing sufficient tin to make the Indian Empire self-supporting as regards this metal, provided the ores be smelted in India. The question of tin smelting on a large scale in India has recently received wide attention in view of the increasing production of ore; but it is doubtful if it could be developed profitably on a large scale at present, unless supplies were received from outside sources to augment the domestic production. In any case competition with the great and old-established businesses in the Straits Settlements, drawing their supplies from all parts of the world, would have to be faced. It is pointed out that the potentialities of the Tenasserim division of Lower Burma as a tin-producing region are fairly well known, but much remains to be done in the better equipment and further development of the deposits. Alluvial deposits especially offer attractive possibilities, and the officers of the Geological Survey of India have repeatedly drawn attention to areas which they considered worth the cost of testing. In the more isolated portions of Amherst, Tavoy, and Mergui districts, lying between the regions where deposits of both tin and tungsten ores are worked, the searches of the prospector should be especially directed to the margins of the great granite intrusions for veins carrying cassiterite, and to the valley gravels and sands of the middle and lower courses of the streams which drain them for alluvial deposits of tinstone.

Chrome ore has been mined at several places in New Caledonia, but present production is limited to the Tiebaghi mine, Paagoumene, which is the richest mine in the country and one of the most productive in the world, states the 'Board of Trade Journal'. Other deposits have been worked at La Coulee, Plum, and Carenage, all near Noumea, and at the Vercingetorix mine in Unia, which is now exhausted.

The Danger of Storing Carbide With Explosives

By Charles E. Munroe

*On March 14, 1921, an explosion occurred at about 6:15 a.m. on the premises of an iron-mining concern, through which two magazines, one containing upward of 9000 lb. of high explosive of the dynamite class, and a second, 60 ft. distant, containing upward of 10,000 No. 6 detonators, were completely destroyed, and a 'crater', 7 ft. deep by 30 ft. in diameter, was excavated in the ground at the place where the magazine containing the high explosive had been situated.

As a rule, any eye-witnesses to the circumstances immediately preceding and directly concurrent with accidental explosions are victims of such explosions, and, therefore, the conclusions reached as to the cause of such explosions must, perforce, be based almost completely on circumstantial evidence. In this instance, because both the explosive and detonators were of approved character; because of the time of the day and the state of operations at the time of the explosion; because the remoteness of the location of the magazines, on the side of a ravine, easily admitted of unobserved approach; because differences existed, and because no obvious cause was at once apparent, there arose suspicion that the explosion was not accidental.

Further investigation and review of the circumstances developed the fact that two full drums of calcium carbide had been stored in the magazine containing the high explosive, and that there was a newly opened box of the explosive placed beside a can of the carbide. Also that between 4:30 and 5 a.m. a watchman had entered the magazine and filled his canister with carbide, being careful to leave the carbide lamp he carried on the outside of the magazine while doing so, and that therefore he was compelled to work more or less "in the dark" while opening and closing the carbide drum and filling his canister. He wore at the time a 'slicker' coat, and hat, and, from the reports of the U. S. Weather Bureau of that date, it appears that rain began to fall at 1 a.m. and continued till 5 a.m. with a precipitation varying from "faint" to 0.07 in. It was possible, therefore, that, "working in the dark", some carbide may have been spilled, possibly upon the explosive in the open box, and that water may have been shed from the watchman's hat and coat. It is evident that there was much moisture in the atmosphere about the magazine.

A somewhat extended search reveals no record of any accident attending the storage of carbide with explosives or of any investigation of the possible effect of carbide upon explosives; but something may be learned as to the propriety of storing them in proximity to each other from a consideration of the known properties of calcium carbide; its observed behavior in storage, transportation, and use; and reports of accidents to which it has given rise.

Calcium carbide as it appears in commerce is a dark crystalline substance with a metallic lustre and is quite hard. It is produced in electric furnaces by heating an intimate mixture of lime and coke, or other form of carbon, to above 3000°C. When pieces of carbide are thrown into water a bubbling or 'boiling' of the water takes place and a gas rises from the water which is easily ignited and burns with a luminous smoky flame. This effect is due to the calcium carbide reacting with the water to produce calcium hydroxide and acetylene. A similar reaction takes place when calcium carbide is exposed to air containing moisture, as air usually does; hence, unless the carbide is stored in air-tight vessels, acetylene is set free and the carbide is eventually decomposed, or 'spoiled'.

From the above it is apparent that acetylene is an inflammable and combustible gas. It is one of the most easily ignited of the inflammable gases, for when heated in contact with air it takes fire at 480°C. Like all other combustible gases and vapors, acetylene forms explosive mixtures with air and is unique in that so far as known it forms a wider range of combustible and explosive mixtures with air than any other gas. Hence, as in the case of any combustible gas, special care should be exercised to prevent acetylene escaping into the air to form such mixtures.

Moreover, acetylene differs from other gases in that during its formation it absorbs heat, therefore falls into the class of chemical compounds styled endothermic compounds. When acetylene is under a pressure of more than 15 pounds per square inch above the atmospheric pressure it can be detonated and it thus becomes a true explosive. For this reason no one should attempt to compress acetylene, certainly to not more than 15 lb., unless it is simultaneously absorbed by acetone, or other proper solvent, and some approved form of porous material. A process for the compression of acetylene has been developed, but it is highly technical and should not be attempted by the inexperienced.

Attention has been called to the fact that calcium carbide and water react to form calcium hydroxide and acetylene. It should be added that this reaction is accompanied, as very many chemical reactions are, with the evolution of heat, the temperature that is realized being dependent on the proportions of the carbide and water, the rate of mixing and the circumstances determining the rate at which the heat set free may escape.

Attention has also been called to the fact that calcium carbide is prepared by heating lime with coke in an electric furnace. Lime is produced by 'burning' natural limestone. It is well known that no substance occurs

*Reports of Investigations, U. S. Bureau of Mines.

pure in nature and that all rock is a mixture of minerals. Therefore, though limestone consists chiefly of calcium carbonate, it often contains a proportion of calcium phosphate which is reduced in the electric furnace to calcium phosphide. Hence calcium carbide has contained, and, unless proper care is taken in the selection of the raw material for its manufacture, may contain, calcium phosphide.

Calcium phosphide is a dark rock-like solid which when thrown into water produces a turbulent reaction, with the evolution of gaseous hydrogen phosphide, and this gas as it issues from the water and comes in contact with the air becomes spontaneously inflamed and burns with a faintly luminous flame and the production of a considerable quantity of white smoke, usually in the form of vortex rings. When calcium carbide containing calcium phosphide comes in contact with water, acetylene and hydrogen phosphide are evolved together and should the phosphide be evolved in sufficient quantity to become inflamed it would ignite the acetylene.

The calcium-carbide industry has, since the invention by T. L. Wilson, in 1892, of a practical method for making it, become of commercial importance, and in the development of its manufacture it has been found that to secure the best yields and highest economic results the raw materials used must be of the highest purity. It is claimed that the manufacturers now so carefully select or purify the materials entering into the manufacture of calcium carbide that acetylene produced from it contains only a safe minimum of foreign substances. It is well, however, to bear in mind that carbide forms a most attractive means whereby to store and transport for use elsewhere the energy of remote water-power, while through conversion into cyanamid it supplies a convenient means for so fixing the free nitrogen of the atmosphere that it may be employed in agriculture, in chemical manufactures, and in explosives. There is, therefore, continued chance of carbide appearing from new sources of manufacture in which less pure raw materials have been used. It has been pointed out that calcium carbide is hard. It is so hard that it may strike fire with steel.

The above discussion indicates a variety of ways in which accidental ignition or explosion may occur with commercial calcium carbide. Since it has become a commercial article there have been numerous reports of such accidents. Those interested in investigating the particulars are referred to the Annual Reports of His Majesty's Inspectors of Explosives in which, since 1900, there has appeared a record of them.

From what has been said it is evidently unsafe to store carbide in the same magazine with explosives or in close proximity to them. Moreover, such storage violates a fundamental rule of practice governing explosives magazines, which is:

Nothing but explosives should be stored in an explosive magazine, and preferably but a single class of explosives; for explosives of different classes may affect one another unfavorably when stored together. Detonators, caps, fuse, and all other mediums of ignition or detonation should be stored at a distance from explosives.

Nickel

The larger part of the world's production of nickel comes from the famous pyrrhotite-chalcopyrite ores of the Sudbury district in Canada, states a U. S. Bureau of Standards bulletin. These ores are at present smelted and refined by three processes, the larger tonnage being smelted in Canada and refined both there and in the United States by the Oxford process. A natural alloy, monel metal, is produced from the same ores by roasting and reducing the copper-nickel matte shipped to New Jersey from the Canadian smelters. Nickel is produced in the United States in several commercial forms, the greater tonnage in the form of 50- or 25-lb. ingots, or pigs, which are used in the manufacture of nickel-bearing alloy-steels. Nickel-shot and electrolytic-nickel cathodes are produced for the use of the manufacturers of nonferrous nickel alloys, nickel-silver and cupro-nickel. Malleable nickel—sheet, strip, rod, and wire—is produced for stamping, fittings, resistance and pyrometer wire, spark-plug points, and kitchen utensils. Nickel castings are produced for the chemical industries for use against corrosive solutions. Nickel is generally useful by reason of its anti-corrosive properties. Monel metal is produced in the usual commercial forms—castings, rod, sheet, or wire—and is valuable because of its resistance to corrosion, its strength at high temperatures, and its resistance to the erosive action of super-heated steam (in turbines and steam-valves).

Besides the nickel or nickel-chromium alloy-steels containing from 1 to 3.5% nickel and largely used for automobile and ordnance construction, a number of other nickel-bearing alloys have interesting and commercially useful properties. Nickel-silver, containing from 52 to 80% copper, 10 to 35% zinc, and 5 to 30% nickel, is used in sheet form for the base metal for silver-plated household ware and other stampings and fittings, in the wire form for resistance wire, and in the cast form for automobile hubs. Cupro-nickel, containing about 15% nickel, the remainder being copper, is used for the manufacture of small-arms bullet jackets. Constantan, containing about 45% nickel, the remainder being copper, is used largely for resistance and pyrometer wire. Ferro-nickel, or 25 to 35% nickel-steel, is used as resistance wire and as Invar having a low coefficient of thermal expansion. Nichrome, and similar alloys, containing from 60 to 80% nickel, together with chromium and iron, is used for resistance wire and as a heat- or temperature-resisting alloy. Manganese-nickel alloys, containing from 2 to 4% manganese and the remainder nickel, are used largely for the manufacture of gasoline-engine ignition points, or spark-plugs.

FERRO-VANADIUM is made in the electric furnace or by the aluminum reduction or thermit process, according to an Arizona State Bureau of Mines bulletin. The carbon content of that made in the electric furnace is greater than in the alloy produced by the aluminum-reduction process. It is claimed that ferro-vanadium produced by the former method also contains vanadium carbide.

Book Reviews

Economics of Petroleum. By Joseph E. Pogue. John Wiley & Sons, New York. 375 pp., ill. For sale by 'Mining and Scientific Press'. Price, $6.

The author of this volume is of the opinion that the United States is facing a critical shortage of crude petroleum, and that the coming year will see sensational developments in the industry. The United States, he says, has maintained a rapidly mounting supply of petroleum during the past few years because of a remarkable coincidence of circumstances that the years ahead give no promise of duplicating. Between 1915 and 1920, the petroleum industry absorbed over three billion dollars, the investment of this sum giving rise to an unprecedented expansion that stimulated production to such a degree that the peak of output was projected into the middle of the period of industrial depression in 1921. Coupled with this rapid expansion from within, the termination of the Great War made available sufficient tanker facilities to open up the cumulative results of a ten-year drilling campaign in the oil-fields of Mexico. Mexican oil, in consequence, flooded the American market, at the same time that domestic production was reacting upward from the stimulus of the vast sums of new capital that were being invested in oil production. Such was the situation at the beginning of 1921, soon after which the price of oil tumbled in the face of a temporary slump in demand. Pool after pool in the Mexican fields went to salt water, some over-night. Profits on domestic oil-field development were reduced, and drilling declined. Demands are now increasing; but the author asks where the needed increases in oil-supply are to come from. The exploitation of foreign fields will be facilitated, but the question still remains unanswered.

Since its inception, the output of the American petroleum industry has expanded at an average rate of 8½% per year; during the past few years this rate has increased to about 10%. In 1921 the United States will consume almost 510 million barrels of crude petroleum; 1922 will probably see a consumption of at least 550 million barrels. With domestic production on the decline and with the output from Mexico being strongly curtailed, there can be but one result according to the author of this book—rising prices and a stringency in supply. The reserves of petroleum are limited in quantity, and the rate at which the supply may be brought to the surface is falling behind the rate at which the demand for oil is growing. The author discusses, in perspective, the more important economic facts relating to the present situation, and endeavors to interpret the changes that are taking place rapidly. The book is designed to be of service to the business man, the engineer, and the practical worker, not only in the petroleum industry, but in those industrial fields that are dependent upon the products of petroleum. The contents are as follows: I. Economic organization of the petroleum industry. II. The resource situation. III. Trend of oil-field development. IV. Trend of oil production. V. Transportation of crude petroleum. VI. Trend of refinery practice. VII. Analysis of refinery capacity. VIII. Outlook for oil refining. IX. Gasoline. X. Kerosene. XI. Fuel oil. XII. Lubricating oils. XIII. Petroleum by-products. XIV. Natural gas and natural-gas gasoline. XV. Marketing of petroleum products. XVI. Analysis of the exports of crude petroleum. XVII. Prices of petroleum and its products. XVIII. Relation between price and production of crude petroleum. XIX. Bearing of automotive transportation upon the oil industry. XX. Cracking. XXI. Composite motor fuels. XXII. Motor-fuel problem. XXIII. City-gas problem. XXIV. International aspects of petroleum. XXV. Mexico as a source of petroleum. XXVI. Relation of the coal industry to the oil industry. XXVII. Oil-Shale. XXVIII. Utilization of petroleum. XXIX. Function of statistics in the petroleum industry.

Metric Versus the English System of Weights and Measures. Research Report No. 42, issued by the National Industrial Conference Board and published by the Century Co., New York. 261 pp., paper. For sale by 'Mining and Scientific Press'. Price, $2.50.

This volume deals with a question of vital and timely importance, not only to the industrialist, but also to every citizen of the United States: shall the metric system be substituted by compulsion for the English system of weights and measures in this country? Agitation toward this end has been carried on during many years, and bills for the compulsory adoption of the metric system have, from time to time, been introduced in Congress. A measure is now before the House and Senate. Because of the importance and far-reaching economic bearings of the subject, the National Industrial Conference Board has prepared this report in order that American industry might be aided by a clear presentation of facts and arguments in determining what its attitude should be toward the proposed change in systems. The report is presented in three parts. The first deals with the history and the present national status of the English, metric, and other systems of weights and measures, respectively. The second part analyzes the application of the English and the metric systems to various specialized fields, such as science, engineering, manufacturing, and trade. The third section sets forth in a judicial manner, without taking a position one way or the other, the arguments advanced by advocates of the English and the metric systems, respectively, for and against the compulsory adoption of the metric system by the United States. The Board was fortunate in being guided in its work by an able advisory committee, composed of men of broad business experience and scientific attainment. This committee consisted of E. M. Herr, chairman, the president of the Westinghouse Electric & Manufacturing Co., Fred J. Miller, a past president of the American Society of Mechanical Engineers, Henry D. Sharpe, the treasurer of the Browne & Sharpe Manufacturing Co., Henry J. Towne, the chairman of the Board of Directors of the Yale & Towne Manufacturing Co., and Frank O. Wells, a former president of the Greenfield Tap & Die Co. These gentlemen have approached the subject from different viewpoints and with differing sympathies in respect to the problems involved; their opinions evidently have been of valuable service in keeping the presentation properly balanced. The report is an accurate and comprehensive collection of information on an important but little-understood subject, and an impartial synopsis of arguments both for and against the proposal that the metric system be adopted in place of the existing system of weights and measures in the United States.

Automotive Repair. By J. C. Wright. John Wiley & Sons, New York. 530 pp., ill. For sale by 'Mining and Scientific Press'. Price, $3.50.

This book meets the need of the man who is expected to make general repairs and to keep the car in operation, whether he be a repairman or an owner. Emphasis is placed on actual repair jobs, rather than on the theory of design or detailed types of construction. The text in Part I covers the principal repair jobs that the general repairman or owner will be called upon to perform. Part II covers the principles of construction and operation that the repairman and owner need to know in order thoroughly to understand automotive equipment. It is stated that a thorough training and understanding of the repair work included in this book will guarantee an experience covering at least 95% of

the problems that may confront the general repairman or owner. The matter in Part II is of such a character that it is more than sufficient to enable him to understand the theory of gas engines and its application to automotive repair work. The book is excellently illustrated throughout with a large number of explanatory figures. The practical jobs discussed in Part I include 40 under 'Chassis Work'; 23 under 'Engine Work'; 26 under 'Electrical Work'; 20 under 'Trouble Shooting'; and 9 under 'Body and Radiator Work'. Part II discusses the chassis and its construction, automotive engines, lubricants and lubricating, electricity applied to automotive equipment, ignition, starting and lighting, engine fuels, carburetors, the cooling system, tires and tubes, and sundry useful information.

Oil Shales. By H. B. Cronshaw. John Murray, Albemarle street, London, W. 80 pp., paper. Price, 5s.

This is another of the monographs that are being prepared under the direction of the Mineral Resources Committee of the Imperial Institute, with the assistance of the scientific and technical staff. Only recently, when the demand for petroleum has so enormously increased and there seemed to be a danger of exhaustion of supplies of natural oil, attention has been directed to other sources of supply, particularly in regard to oil shales, which are rich in bituminous substances and yield oil and gas on distillation. Oil shales have been worked for the production of oil for a number of years in Scotland, France, and a few other countries; lately the deposits of the Kimmeridge Clay in England have been receiving attention, and those in Norfolk are under development. Much research has also been undertaken on the vast oil-shale deposits in the United States, especially in connection with those of Utah, Colorado, and Wyoming; those at De Beque, Colorado, are being actively developed. The monograph under review describes oil shale and the substance torbanite; the mining and distillation of oil shale; and the composition and properties of shale-oil. Descriptions follow of deposits of oil shale and torbanite in various parts of the British Empire, including those of the Utrecht district of Natal, the Wakkerstroom district of the Transvaal, Albert county in New Brunswick, Pictou county in Nova Scotia, Blue Mountains in New South Wales, and the Mersey district in Tasmania. Accounts of non-British deposits are also given, and include those of the United States, France, Bulgaria, and Brazil. A map showing the oil-shale deposits of the world and a bibliography conclude the volume.

Lubricating and Allied Oils. By E. A. Evans. E. P. Dutton & Co., New York. 128 pp., ill. For sale by 'Mining and Scientific Press'. Price, $4.50.

This is one of the D-U, or directly useful, technical series. It is explained that technical books of the past have arranged themselves largely under two sections: the theoretical and the practical. Theoretical books have been written more for the training of college students than for the supply of information to men in practice, and have been filled with descriptions of an academic character. Practical books have often gone to the other extreme, omitting the scientific basis upon which all good practice is built, whether discernable or not. The books in the D-U series are intended to occupy a midway position. The information, the investigations, and the discussions are to be of a directly useful character, but must at the same time be wedded to that proper amount of scientific explanation that alone will satisfy the inquiring mind. As stated in the foreword, the actual user of lubricating oils has been handicapped in the past because of a want of guidance, and has had to draw upon his own experience and that of his friends, or rely on the advice of the oil manufacturer, which though good in the main often leaves much that is lacking. The present treatise aims to indicate the fundamental considerations in the selection of a good lubricant. The author is an engineer whose experience in all branches of the subject enables him to write as an authority. The contents of the book are as follows: I. History of petroleum. II. Oil refining. III. Occurrence of fatty oils. IV. Physical tests. V. Chemical tests. VI. Oxidation of petroleum. VII. Oleography. VIII. Lubricants. IX. Oils employed. Appendix.

Oil and Gas Rights. By R. S. Morrison and Emilio D. de Soto. Bender-Moss Co., San Francisco. 1115 pp. For sale by 'Mining and Scientific Press'. Price, $10.

As stated in the preface, the passage by Congress of what is known as the Oil and Gas Leasing Act, by which all deposits of coal, phosphate, sodium, oil, oil-shale, and gas were withdrawn from the public domain, and the disposition and control of such deposits taken over by the Government under regulations promulgated by the Secretary of the Interior, suggested the necessity for this work. It contains the latest decisions and principles concerning the rights of the owner in fee of lands not affected by the Act, containing oil or gas lands, the rights of lessors and lessees, and of all persons who have contracted relations concerning the same; and treats of the various topics and subjects incident to the laws governing the owning, leasing, production, sale, and transportation of oil and gas, with the latest text of the statutes of the States that have legislated upon oil and gas rights. A full text of the Oil and Gas Leasing Act is given, with an analysis of its provisions. An attempt is made to interpret those sections in which the meaning is in doubt; and the latest decisions of the Department construing some of the provisions of the Act are given. The book concludes with a number of useful forms and a glossary.

Recent Publications

Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1919. Mines Report. By C. N. Gerry. I:19, U. S. Geological Survey, 1921. 46 pp. From Mineral Resources of the United States, 1919, Part I.

Deposits of Manganese Ore in Montana, Utah, Oregon, and Washington. By J. T. Pardee. Bull. 725-C, U. S. Geological Survey, 1921. 103 pp., ill. From Contributions to Economic Geology, 1921, Part I.

Geology of the Cement Oil Field, Caddo County, Oklahoma. By Frank Reeves. Bull. 726-B, U. S. Geological Survey, 1921. 45 pp., ill., maps. From Contributions to Economic Geology, 1921, Part II.

Contact-Metamorphic Tungsten Deposits of the United States. By Frank L. Hess and Esper S. Larsen. Bull. 725-D, U. S. Geological Survey, 1921. 64 pp., ill. From Contributions to Economic Geology, 1921, Part I.

Investigations of Zirconium with Especial Reference to the Metal and Oxide. Historical Review and Bibliography. By J. W. Marden and M. N. Rich. Bull. 186, Mineral Technology 25, U. S. Bureau of Mines, 1921. 147 pp., ill., index.

Deposits of Chromite in California, Oregon, Washington, and Montana. By J. S. Diller, L. G. Westgate, and J. T. Pardee. Bull. 725-A, U. S. Geological Survey, 1921. 84 pp., ill. From Contributions to Economic Geology, 1921, Part I.

Mineral Resources of Alaska. Report on Progress of Investigations in 1919. By Alfred H. Brooks and others. Bull. 714, U. S. Geological Survey, 1921. 237 pp., index, maps. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 35 cents.

DATE OF INSTITUTE MEETING CHANGED

The meeting of the San Francisco Section of the Institute that was announced for December 20 has been postponed one week until December 27. H. W. Morse will read a paper on the 'Present Status of the Treatment of Mixed Copper Ores'.

TERMS FOR THE MERGER OF ANACONDA COPPER MINING CO. WITH AMERICAN BRASS CO.

A plan was formulated in New York on December 15 by directors of the American Brass Co. meeting with C. F. Kelley, president of the Anaconda Copper Mining Co., and Charles F. Broocker, chairman, whereby American Brass stockholders will shortly be offered the option to dispose of their shares to Anaconda for $150 in cash and three shares of Anaconda against each share of American Brass.

At this price the $15,000,000 capital stock of American Brass, if purchased in its entirety, would cost Anaconda in cash and stock $45,000,000, and of this $22,500,000 would be cash. If control passes to Anaconda it will mark one of the most important steps in the evolution of the brass and copper business. Anaconda has been drawing wire and rods at Great Falls for some time and has been able to command the Pacific Coast market by reason of advantages over the Eastern manufacturers in the matter of freight and other charges. American Brass stock during the past few weeks has risen from around $165 per share to just under $300. Arthur Curtiss James has long been one of the largest individual stockholders. Significance attaches to this statement when it is realized that Mr. James also figures as one of the heavy holders of Phelps Dodge Corporation, of which he is vice-president. Cleveland H. Dodge, another vice-president, has also an important ownership in the Brass company.

NEW IDRIA QUICKSILVER MINING CO. IS GIVEN JUDGMENT FOR LARGE SUM

A verdict for $1,803,364.05 was awarded the plaintiff at Providence, Rhode Island, on December 16, in the suit of the New Idria Quicksilver Mining Co. of California against the British-American Manufacturing Co. of New York in the United States District Court there. The verdict followed ten days of testimony in the $2,500,000 suit of the New Idria company, which alleged that the British-American company had entered into a contract with the plaintiff company for the purchase of about 11,000 flasks of quicksilver, but had failed to fulfill the agreement.

GRANBY CONSOLIDATED MAKES 11-CENT COPPER

The recent wage-reduction and the institution of various operating economies are finding reflection in the cost sheets of Granby Consolidated Mining, Smelting & Power Co. of British Columbia. The company is at present laying its copper down in New York at a total cost, before taxes, of 11c. per pound. This compares with average cost in the early months of this year of 12½ to 13¾c. per pound and means that Granby can make a modest profit even on the present relatively low price for copper. Granby is one of the few mines that remained in operation when over 90% of the country's copper companies suspended production in April of this year. In the first six months of 1921 the company ran behind about $300,000, but with the turn of the half year and the full effect of its wage-reduction being felt, the figures have been getting larger on the profit side of the ledger. In the nine months to September 30, Granby produced nearly 22,300,000 lb. of copper, indicating a production of inside 30,000,000 lb. of copper for the whole year. The company has sold metal during the past two months and its financial position shows improvement over that at the first of the year.

INCREASED PRODUCTION OF SILVER-LEAD ORE IS NOTED IN UTAH

A recent survey reveals the fact that production of lead in Utah is about 50% of normal. The largest lead producer in the State, the Utah-Apex property at Bingham, which has produced as high as 50,000,000 lb. per annum, has been closed since the early part of the year, when the price of the metal dropped below 5c. per pound. The Pittman Act is responsible for the large output of silver-lead ores from the Tintic and Park City districts. The Murray smelter reports that shipments of silver-lead ores have been increasing lately, and that three furnaces out of eight are in operation. It is probable a fourth furnace will be blown-in shortly. The United States smelter at Midvale has been running three furnaces out of seven since January 1. The International smelter at Tooele has been closed since July 1.

NIPISSING MINES CO. OPENS NEW OREBODY

On vein No. 64 the Nipissing Mines Co., of Cobalt Ontario, has opened a new body of ore that in places assays as high as 2000 oz. silver per ton over a width of approximately two feet, according to E. P. Earle, president of the company. The exact extent of this orebody has not yet been determined, but development is being concentrated on this work, as this is the biggest find in point of size made at Nipissing's property for some time. In the last two months the company has developed a body of high-grade silver ore on vein 251 at its No. 63 shaft. This vein varies in width from one to four inches and the ore contains from 2000 oz. silver to as high as 5000 oz. The management states that it does not as yet know the extent of this development, but as far as operations have progressed the grade has been maintained. To bring back its reserves to something like their former status, the Nipissing management has been concentrating on underground development. Having an abundance of working capital and with operating costs drawn down to a minimum, the company has been able to perform this extraordinary development work at a moderate expense.

STAR-FEDERAL CASE IN THE COEUR D'ALENE IS SETTLED OUT OF COURT

The litigation between the Star Mining Co. and the Federal Mining & Smelting Co., which has been in court for almost four years, was suddenly terminated on November 10, when formal announcement was made that an agreement had been reached by the litigants. The case was being tried before Judge F. S. Deitrich, of the United States District Court at Coeur d'Alene. The hearing was for the purpose

of determining the amount the Federal company should pay the Star on account of ore removed from the Star ground in the operation of the Morning mine, owned by the Federal. Under the terms of the agreement the Federal company pays the Star $350,000 in full settlement for all ore removed and relinquishes all claim to the disputed ground. As if to clinch the transaction, the Federal also gives the Star an option for 90 days on the Iron Crown claim and that portion of the Grouse claim lying west of the west line of the Morning claim extended across the Grouse, practically half of the claim, for a consideration of $100,000. The Grouse claim lies south of and alongside the Morning and Evening Star, the latter owned by the Star, and it was the right to the apex of the vein which is bisected by the side-line between Evening Star and Grouse that led to the litigation. A branch of the Morning Star vein extends through the Iron Crown claim, which joins the Grouse on the west. By taking over the Iron Crown and half of the Grouse, the Star becomes the owner of all the ground directly or indirectly connected with the litigation and is therefore protected from any possible cause of further dispute.

RENEWED INTEREST IN THE WARREN DISTRICT OF IDAHO

George W. Cooper, of Los Angeles, California, visited Warren, in Idaho county, Idaho, several months ago; he investigated the mining resources of the district and, after satisfying himself that there were immense deposits of gold and silver ore remaining yet untouched, he and his associates took a bond and lease on the Thomas Creek gold-placer property formerly owned and operated by Charles Curtis and W. P. Grindle. This property comprises an area of about 320 acres of land of which practically 290 acres is virgin ground which is estimated to yield better than 30c. gold per yard. The overburden ranges from approximately 6 to 18 in. of soil, leaving about 9 ft. of pay-dirt. One sample assayed, under date of November 17, 1921, by Smith, Emery & Co. gave the following results: 484.60 oz. of gold per ton, valued at $10,016.68; it contained also 22 oz. of monazite sand per yard of dirt. The property will now be operated by the Co-Operative Mines Co. of Warren, Idaho, with headquarters at Warren. Several other companies are also organizing to develop and operate other properties in the spring. One of those companies will develop and operate a large deposit of monazite sand. Mesothorium is today known the world over as a substitute for radium, and the Warren deposit of monazite sand is considered to be the richest known deposit yet found in the West.

WESTERN BRANCH OF CANADIAN MINING INSTITUTE WILL MEET IN FEBRUARY

The Western Branch of the Canadian Institute of Mining and Metallurgy will hold its annual meeting at Vancouver during the first week in February. Some interesting papers will be read, among which may be mentioned 'The Geology of the Britannia Mine', 'Mining and Metallurgical Practice at the Britannia Mine', and a number of papers on the geology of and mining practice at the Vancouver Island coal mines. Owing to the continued high price of coal and the marked decrease in production, these collieries are attracting a considerable amount of attention.

SUBSTANTIAL REDUCTION IN STOCKS OF REFINED COPPER SINCE JULY 1

The 'Boston News Bureau' has made a careful survey of all the factors entering into an analysis of the copper status —production, exports, and domestic consumption—and finds that since July 1 there has been a reduction in the stock of refined copper in this country amounting to almost 300,000,000 lb., or 40%. In other words, home meltings plus exports have exceeded United States production of refined copper by 290,000,000 lb. Of course, this is an estimate, but it is arrived at after painstaking investigation, conferences with large producers and refiners as well as with copper consumers.

The figures are as follows, based on actual and partly estimated returns (in pounds):

U. S. stocks of refined copper on July 1, 1921	750,000,000
U. S. production of refined from July 1 to November 30, 1921	225,000,000
Total	975,000,000
U. S. consumption, July 1 to November 30, 1921	250,000,000
Exports from July 1 to November 30, 1921	265,000,000
Total	515,000,000
Estimated visible supply, December 1	460,000,000
Stocks of blister copper, December 1	165,000,000
Total	625,000,000

A stock of 460,000,000 lb.—and this includes 325,000,000 lb. held by the Copper Export Association—while large, is not the threatening menace which our surplus stock on January 1 last appeared to be. Our big producers are still closed down tight, and it would take many months to get them back to their normal stride even were resumption orders issued immediately. To the visible supply of 460,000,000 lb. must be added 165,000,000 lb. of potential product or semi-finished material known as pig- or blister-copper. This crude product is at the refineries awaiting treatment. It is material which has been mined, smelted, and transported to the Eastern seaboard awaiting the finishing process by which it is made into marketable copper.

The figures above do not include stock in process—en route to or in the refining-vats—beyond the 165,000,000 lb. of accumulated matte above referred to. The 'billion-pound surplus' of a year ago now shrinks to 625,000,000 lb. of visible supply, and of this amount only 460,000,000 lb. is available for immediate delivery, with 300,000,000 lb. or thereabout ear-marked for export. Of course, the latter must be included in any estimate of the available world supply.

PROPOSED SUBSTITUTE FOR ELECTRIC POWER.

Representatives of a Swedish engine company offer a solution of the power problem in Northern Ontario which is interesting some of the mine managers. They propose to supply oil-engines of size sufficient for the largest mines at an initial cost for installation of $125 per horse-power, with a guarantee that power con be produced by fuel-oil at $40 per horsepower-year, which would be a considerable saving over present hydro-power rates. One drawback is that it would take a year to make delivery and complete installations.

COLUMBIA SECTION OF THE INSTITUTE TO MEET AT SPOKANE

The eleventh annual meeting of Columbia Section of the A. I. M. & M. E. will be held at the Davenport hotel, at Spokane, on December 28. The nominating committee has submitted the following names of members for officers for the coming year: Rush J. White, of Wallace, Idaho, for chairman; Frank M. Smith, of Spokane, for vice-chairman; and L. K. Armstrong, of Spokane, for secretary-treasurer.

ARIZONA

Ajo.—The New Cornelia Copper Co. has resumed shipments of copper to the East. Shipments will remain for the present at about one car per day. Production still continues at about 1,500,000 lb. of copper per month.

Jerome.—In a recent interview given at Jerome with Charles W. Clark, general manager for the United Verde

Copper Co., he stated that conditions of the copper-metal market at present pointed to a resumption of operations at the United Verde mine and smelter some time in February.

Morenci.—Walter Douglas, president of the Phelps Dodge Corporation of New York, stated, just prior to his recent departure from Morenci for New York, that the output of the No. 6 concentrator at Morenci will be doubled as one means for alleviating unemployment in this district. The mill will be remodeled and increased in size, he said. On December 26 the Phelps Dodge company will take over the holdings of the Arizona Copper Co., according to Douglas, and mining operations of the newly acquired properties will be enlarged.

Oatman.—The mill of the United Eastern is handling 300 tons per day. About 70 tons of ore per day is coming from the Big Jim property, by tramway.——The Tom Reed mill is closing a two-weeks' trial run, stopping to determine the accuracy of the sampling. For the period the mill has been handling 125 tons per day, about 25% above what had been expected. On resumption of operations there is to be custom service for ores of the United American and other Oatman properties. There is belief that this custom work will cause renewed activity in the Oatman section, where many mines have relatively small available amounts of ore from which enough profit might be secured to continue their work of development.——The mill of the C.O.D. Mines Co. has been started, with daily consumption of about 60 tons of ore. Much of the ore is from the 500-ft. level, where the zinc content has been found much lower than in the upper workings. A. D. Storke is manager. Ben Bennot is in charge of mine operation and W. Rith is in charge of the mill.

Samples across a ¾-in. seam at 40-ft. depth in an old shaft of the Enigma mine in Weaver district gave returns of 10 oz. gold and 1800 oz. silver per ton. Robert Good and Frank Hodge are working the mine under bond from its owner, W. O. Ruggles.

Superior.—It is rumored that the Queen Creek Copper Co. is negotiating for purchase of the holdings of the Grand Pacific Copper Co. The property lately was visited by Messrs. Mackay and Stephen, two Scottish capitalists also heavily interested in the Dundee-Arizona mine at Jerome. Grand Pacific has shipped a number of carloads of good ore from comparatively shallow workings.

Report has come from the Kay mine, 40 miles north of Phoenix of the finding of a large and rich copper orebody in an extension of the workings on the 800-ft. level. The property is in charge of George Long, one of the discoverers of the United Eastern at Oatman.

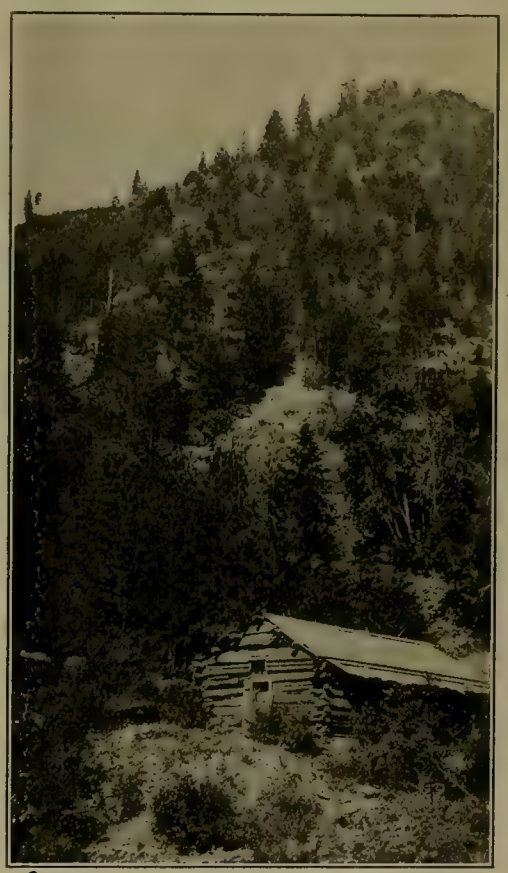
Willcox.—According to the latest report, the Central Copper Co. is employing 250 men in its development of the Mascot and Central properties in the Dos Cabezas district, 14 miles south of here. On hand, in cash and bills receivable, the company now has $917,525, an increase of $526,293 within a year. John W. Prout, Jr., manager, has opened 11 new orebodies during the year in the Mascot section, while the development in the Elma section is declared most gratifying. New hoisting equipment has been installed on the Mascot. The properties now have about 70,000 ft. of development. The Central is working 30 claims of its own and 56 held under a 20-year lease from the Mascot Copper Co., in all with an area of 1380 acres. Connection with the Southern Pacific at Willcox is by a broad-gauge railroad that had been built by the Mascot company.

CALIFORNIA

Colfax.—The tunnel of the Blue Channel mine at Iowa Hill, being driven by a syndicate of Pittsburgh capitalists, is now in 1800 ft. Lyman Gilmore, who is in charge of the work, states that patches of high-grade gravel have been found at intervals and that the expectation is that the solid channel should be reached within 600 ft. The channel-system is presumed to be the same as that on which the Morning Star and Big Dipper properties were located.

Grass Valley.—It is announced that the Intermountain Development Co., of Salt Lake City, has purchased half the capital stock of the Bullion Exploration Co. and that the Bullion property will be re-opened at once. The group comprises 130 acres of good ground and covers about a mile of the Bullion and Union Jack lodes. Prior to 1900, the different properties were credited with a yield of $1,000,000, one-half of which came from the Bullion Consolidated. Henry I. Moore and George Mainhart are officials of the new company.

Kelso.—The Quo Vadis mine, a former producer of rich gold ore, has changed hands and is to be worked in a more modern way. A new Rix air-compressor and 30-hp. engine,



In the Coeur d'Alene Region of Idaho

as well as four air-drills, have been purchased and are being installed. Housing for the machinery is now being erected. The ore is a 'sugary' quartz in quartz-porphyry and carries gold, silver, and lead with a trace of copper.

Randsburg.—The Silver Dike Mining Co. has permission from the Commissioner of Corporations to sell 1½ million shares of stock at 20c. per share. Whenever shares are sold for cash the company is to issue to S. S. Rapp and associates a like number of shares up to 1,000,000 in exchange for the transfer of certain mining claims. The 1,000,000 shares to be issued to Rapp are to be deposited and held as an escrow. The company is permitted to pay 20% on the sale of its stock.

Sutter Creek.—W. P. Henry, president of the Central Eureka Mining Co., states that an extension of one year on

the payment of the deferred instalment on the South Eureka mine will give the company until February 1, 1923, before it will be necessary to decide on the advisability of making the payment. A new 85-ft. all-steel head-frame and a large electric hoist are now being erected. The company hopes to have this new equipment ready to operate early in January and will then be in a position whenever it becomes necessary to sink the main shaft 1500 ft. below the new level that is now being opened.

Tower House.—Charles Garrett, Robert Garrett, and Jack Pepper are doing development work on the Double Header mine near this place. Charles Garrett located the mine a few years ago. Finding it was on railroad land, he bought it from the railroad company.

Tuolumne.—The Casa Madera Mining Co. has installed heavy machinery and is driving a 2000-ft. tunnel from the North Fork slope. Work will be continued throughout the winter.

COLORADO

Alma.—The Colorado Power Co. is extending its line through Alma to Fairplay, and constructing a branch up Mosquito gulch to furnish power to the Brownlow mines, now operated by Detroit capitalists, who are opening a good vein of mill-grade ore over 20 ft. wide, and other smaller veins of ore of better grade.——The Mascotte Tunnel Co. will continue operating this winter; a building has been constructed to house an electrically driven compressor. The company owns claims extending about two miles on each side of the course of the tunnel.——Teams from the London mine are keeping the trail open for hauling ore; sleds will be substituted later in the winter.——The Dolly Varden continues steady production of silver ore containing some gold and lead. Recent shipments have settled at from 60 oz. silver for second-grade to as high as $340 per ton for first-class ore.

Aspen.—The Hope tunnel has been extended 40 ft. beyond the point where the new ore-shoot was cut, but to date the grade is low. A carload carefully sorted has been shipped.

Creede.—The Commodore mine has been leased and men are engaged cleaning out the No. 3 and No. 4 tunnels preparatory to taking out ore for shipment. The property has been leased by J. W. Wilson, and engineers who have examined the old workings; a large tonnage of both milling and shipping ore is in sight.

The Chipeta M. M. & S. Co. is extending the main drift on the H. A. C. property to prospect virgin territory and is rapidly gaining depth. It is planned to construct a mill near the railroad, to be connected by aerial tram when sufficient ore is blocked out.——Work has started on the Little Jessie, on Corbett creek; other claims of the Teller group are to be developed by the leasing company formed by Judge Pryor and associates at Aspen.

Georgetown.—A station is being cut in the Capital tunnel by the Gilpin Development Co., of Boston, preparatory to installing an underground hoist over the winze being sunk on a vein exposed in the floor of the tunnel. The Capital company mined good ore from a stope carried up 300 ft. above the tunnel-level, but no work has been done to date below the tunnel.——The Nicholls, an old silver producer in the 'sixties, which has been inactive for more than 50 years, is to be operated by local miners. Old-timers state that, when work last ceased, a vein of rich ore was showing in the bottom of the shaft and the last ore shipped returned $430 in silver per ton.

Lake City.—A survey has been made and plans prepared for construction of a hydro-electric power-plant of 6000 hp. to supply power to the Golden Fleece properties. The company controls mining property and reservoir sites, including Lake San Cristobal, with capacity of 30,000 acre-feet, necessary to the project.

Silverton.—Lessees on the Wyman group, on Anvil mountain, have opened a vein 6 ft. wide, carrying four pay-streaks 6 to 8 in. wide, at a depth of 700 ft. from the surface, sampling 80 to 100 oz. silver. The property is developed by tunnel, one mile from the railroad; it is accessible at all seasons, so that operations will start this winter.

IDAHO

Coeur d'Alene.—Ore has been opened in several parts of the property of the Independent Lead Mines, which consists of 12 claims. In the Independence claim the Morning vein has been cut at a depth of 100 ft. and at a point 50 ft. east of the Federal line. The body is 15 ft. wide and contains high-grade carbonate and galena ore. Shipments are said to have been made from this exposure in earlier days. This vein is exposed in the Victor claim by a carbonate-iron blow-out at a point 3000 ft. from the scene of discovery.

The Ajax Mining Co. has started work on the mile of tunnel which it will drive at a cost of $90,000 to reach a point directly under the ore-shoot in the upper workings. The tunnel, 6 by 8 ft. in the clear, has already been driven 260 ft. in somewhat broken ground that requires timbering, according to reports at hand. Two shifts of three men each are making 5 to 6 ft. each shift when not timbering.——In the Nellie mine in the Osborne district a rich ore-shoot has been discovered in the lower tunnel. The property is being worked by Peter Gardner and associates, lessees, who took it two months ago and already have shipped some good ore from the upper workings to the Bunker Hill smelter. The extent of the find is not determined, but it gives 300 ft. additional depth to the ore.

Four feet of ore has been opened on the 400-ft. level in the Chicago-Boston mine, two miles west of Wallace. Assays of the 4 ft. of ore returned 11.2% lead and 11.5 oz. silver; in the middle is about 1 ft. of ore that assays 48% lead and 42 oz. silver. The strike is 350 ft. east of the shaft and gives a depth of about 1200 ft. One carload of sorted ore has been accumulated from the 200-ft. level; it will be shipped to the Bunker Hill smelter. It is expected this ore will run about 50% lead. More of this ore will be mined from the 200-ft. level and these shipments are expected to pay a large part of the expense of developmnt.

Pioneerville.—The Golden Age Mining Co. has opened a vein between 4 and 5 ft. wide at 295 ft. in a cross-cut on the 250-ft. level. A sample taken across the entire face assayed $30 in gold and $10 in silver. The company is drifting both ways on the ore and will soon start a raise to connect with the old workings above. Arthur W. Stevens is superintendent.

Priest River.—The Lucky Abe mine on upper Priest lake is developing splendidly. Three good veins traverse the property. One is said to be 80 ft. wide, carrying 8% copper, $1 per ton in silver, and 85c. in gold. The tunnel is in 40 ft. Another vein, 30 ft. wide, is said to contain 100 oz. silver per ton. The vein has been cross-cut and the work is being done in the hanging wall. Assays of 26% copper and $12 per ton in gold are reported from the third lode, said to be 22 ft. wide. Peter Chase, of Coolin, and Samuel Edelstein, of Spokane, are managers of the property.

MICHIGAN

Houghton.—Isle Royale is in a position to give a good account of itself when operations are resumed at that Calumet & Hecla subsidiary. The mine is well opened in ground that will run nearly 18 lb. per ton, the vein showing uniformity of content with depth. Powerful electric pumps, in No. 4, 5, and 6 shafts, have taken care of the water, and the mine is physically in good condition. Many of the former employees live at or near the mine, and the only delay, once

orders are given to start, will be that incident to the replacing of underground equipment and the overhauling of machinery. Some timbering will be necessary, but this is not expected to interfere seriously with actual mining work.

Isle Royale costs were high during the war years, running up as high as 16.8c. per pound in 1920, but in common with other mines of the district, Isle Royale will benefit by a reduction of costs in every department when operations are resumed. The labor cost will be notably less and economies will be effected in purchasing coal and other supplies.

Construction of the new collar for Gratiot No. 2 shaft and bases for the new hoist, preliminary to the resumption of sinking, is well under way. Shaft repairs will be undertaken as soon as the collar is complete. Surveys have been made for track extensions from the mine to the Mineral Range, over which shipments will be made to the Point Mills plant. Before production will be attempted on a large scale, however, it will be necessary to install a new hoist at the Seneca shaft. Opening work in Seneca continues in splendid ground.

Mine and Mill of the Leadville Mines Co. at Gerlach, Nevada

The third level drift, north, with which Gratiot will be connected, shows no diminution in content. Considerable 'mass' is being encountered in all drifts.

Mohawk will finish the year with a production of close to 14,000,000 lb., equaling the 1916 output and greater than the production of any year since. It is understood to have no more than normal stocks of metal on hand, having managed to sell the greater part of its output from month to month. A full program of drifting and stoping is under way in all four operating shafts, while sinking is proceeding in No. 1 and 6 shafts. The yield holds well to the average of about 24 lb. per ton.

MONTANA

Helena.—Ten tons of float quartz from the Bamboo Chief claim, near Virginia City, netted the lessees $1600 from the East Helena smelter of the American Smelting & Refining Co.——A car of silver-gold-lead ore is ready for shipment to the East Helena smelter from the Carbon Hill mine in the Grass Valley district. The ore assays about $50 per ton.

Marysville.—The Barnes-King Development Co. is operating the Shannon mine at Marysville successfuly. The Penobscot mine is being developed by an adit.

NEVADA

Argentite.—Drifts driven a total of 200 ft. from the bottom of the 100-ft. shaft on the Frances have been in ore of an average value of $25 to $30 for this distance, according to F. H. Taylor, manager, who says the average width of the ore is 6 ft. A three-drill air-compressor has been bought for sinking the shaft another 100 ft. and doing 300 ft. of additional drifting from it. There is exposed in the Ecklund-Paget group, one mile east of the Frances, a 33-ft. width of ore of an average value of $14, according to Taylor. This ore is at a depth of 50 feet.

Austin.—Discovery of rich gold ore about three miles east of here has resulted in the location of over 30 claims and prospecting over a wide area. The original strike was made by Peter O'Brien while prospecting for the source of placer gold in this district. The quartz closely resembles the rich material found two years ago in the Birch Creek district, farther to the east.

Carson City.—S. S. Arentz and other Western Congressmen are endeavoring to secure a modification of the rules governing the purchase of silver under the Pittman Act, whereby the assay-office at Carson City can receive consignments of bullion for which they will pay at the rate of $1 per ounce of contained silver. An allowance for express charges to San Francisco must also be made. Since the Pittman Act has been in effect, 'dollar' silver has been received only at San Francisco, Denver, and Philadelphia, the various Government assay-offices paying only the market price for the metal.

Gerlach.—A. A. Codd is planning more extensive development of the property of the Leadville Mines Co. During this year the gross production has been more than $153,000, which is a good record, considering that shipments were not begun until after July 1. All of this production has come from between the 190- and the 300-ft. levels. Codd now purposes to sink to the 500-ft. level and begin drifting at both the 400- and the 500-ft. levels. The mill is well equipped and the ore is concentrated to about 6 into 1. This gives concentrates of about $200 per ton. The mill is now handling an average of 35 tons per day, which will be increased to 50 tons. A new 75-hp. boiler is being placed, which will give the needed extra power.

Goldfield.—The Silver Pick has shipped two carloads of ore from an intermediate level between the third and fourth. This ore is in the extension of the orebody that was mined on the third level and in the winze. Ore also has been found in a drift driven 100 ft. north from the bottom of the winze.

Hornsilver.—Although the good conditions in the Orleans have not yet led to other work in the district on anything but a small scale, sales of groups of claims, the formation of companies, the presence of mining engineers from outside Nevada, and deals of various kinds indicate that there will be much activity in the spring and summer. With ore opened by drifts and cross-cuts for 300 ft. on the 600-ft. level, the Orleans company is now opening the 700-ft. level,

where the south-east drift has been driven 70 ft. in ore, a 30-in. width of which assayed $100 for practically the 70 ft. The remainder of the width of the drift assays $20. Among the engineers who have examined the mine recently are Roy H. Marks, with the United Verde Extension at Jerome, and F. E. Perry of Los Angeles.——Harry De Votie of Goldfield has sold control of the Hornsilver American company to E. G. Reinert, J. F. Erisman, and G. T. Hoffman of Denver. The company owns eight claims from which $10,000 to $12,000 worth of high-grade ore has been shipped, carload shipments assaying as high as $70. The mine is well equipped with machinery at two shafts, one 200 ft. deep and the other 140.

Pioche.—Eastern and local interests have recently taken over a number of properties in the Silver Park district, situated about 45 miles north of here near the Atlanta gold mine, which is said to have a proved reserve of 100,000 tons averaging $9 gold and silver. The mines include the Nevada Park, the Miner's Delight, the Great Eastern, and the Conway & Bradshaw properties, comprising the best of the mineral area. Besides these patented mines, the Fan Tan group of four claims has been acquired, giving sufficient territory for future mining operations. All these properties have been producers during the past few years. Only the former low price of silver and the excessive cost of transportation, which has rendered unprofitable the mining of ore, except such as is of bonanza grade, has held back the development of the district.

UTAH

Alta.—Assays of the orebody recently opened in the old Emma mine give returns of from 12 to 55% lead, and from 14 to 72 oz. silver per ton. The thickness of the deposit has dropped from 4 ft. to 14 inches in 12 or 14 ft. of drifting.

The Columbus-Rexall Consolidated Mines Co. is shipping an average of 250 tons of ore per month. Practically all of this production is coming from the No. 10 workings, close to the Cardiff line, and averages about $40 per ton net. The company employs 18 men underground. Recently a new orebody was cut about 5000 ft. from the portal of the main tunnel. The Columbus-Rexall now has three openings into the Cardiff mine, which permit of better ventilation for both properties.

Boxelder County.—The new tunnel being driven at the Vipont Silver property is progressing at the rate of 200 ft. per month. As soon as construction now under way is completed, the mill will be in a position to treat 175 tons of ore per day.——The Utah-Idaho Mining Co., adjoining the Vipont, has installed a compressor and power-drills. Development will be carried on during the winter.——In the Golden Eagle property, a tunnel is being driven to explore ground in the vicinity of the Vipont boundary line.

Eureka.—The United States Smelting Co. has discontinued the mining of iron ore at the Dragon Consolidated property, due to an over-supply of fluxing material at the Midvale smelter.——Allison Brothers, of Heber City, announce that they will develop the Lucky Shepard property, in the western part of the district, near Desert mountain. Several years ago sheep-herders discovered a vein of high-grade silver-lead ore within a few feet of the surface.

Ore shipments from this district for the week ending December 10 totaled 176 carloads, as against 166 for the preceding week. The Tintic Standard shipped 61 cars; Chief Consolidated, 43; Victoria, 16; Dragon, 15; Iron Blossom, 12; Eagle & Blue Bell, 8; Mammoth, 4; Colorado, 4; Swansea, 4; Centennial-Eureka, 3; Plutus, 1; Showers, 1; Gemini, 1; Bullion-Beck, 1; Empire Mines, 1; Tintic Drain Tunnel, 1.

Work of overhauling machinery at the Grand Central property has been completed. Paul Hilsdale, who has taken the property under a lease and bond, states that 120 miners have applied for leases, while 60 applications have been granted. It is probable that within a month this number will be doubled. Hilsdale has three crews of surveyors at work, preparing new maps. A transmission-line has been built from the Chief Consolidated mine to the Grand Central, and when the necessary equipment has been installed, the surface machinery will be electrically-driven instead of operated by steam.

Milford.—Joseph F. McGregor, John Goodwin, and Earl Alverson, of Beaver, have taken a lease and bond on the old Moscow property, about 12 miles from here. Development work has been started, and a car of silver-lead ore has been shipped to a Salt Lake valley smelter.

Park City.—Ore shipments for the week ending December 10 totaled 2161 tons, as compared with 2068 tons the preceding week. The Judge allied companies shipped 1172 tons; Silver King Coalition, 527; Ontario, 463.

Development work has been carried on at the Revelator property in Snake Creek canyon during the past summer, according to Samuel Hair, who is in charge of the work. One shipment was made, and the second will go forward within a short time. In the Vassar No. 2 claim, owned by H. T. Coleman and Hair, development is being done under the direction of E. M. Hardy.

Salt Lake City.—In a decision handed down by Federal Judge Tillman D. Johnson on December 16, the Utah-Apex Mining Co. was awarded $1,154,928.98 against the Utah Consolidated Mining Co. for ore extracted from property which had been decreed by the Court as belonging to the Utah-Apex company. Proceedings in execution were stayed for a period of 30 days to give each party time to file notice of appeal, if either so desired. In his previous decision, Judge Johnson held that if the rules laid down by the court to govern the method of arriving at an accounting were closely followed, the figures reached should agree. However, when the revised figures were presented to the court, the Utah-Apex held the amount to be $1,171,000 and the Utah Consolidated contended that it should have been $1,070,000, or about $100,000 less.

TEXAS

El Paso.—It is planned by the American Smelting & Refining Co. to establish here a large metallurgical experimental plant for the testing of ores. The ore for this plant will come chiefly from mines in Mexico, it is stated.

BRITISH COLUMBIA

Barkerville.—In the case of the Mines Operating Co. v. the Lightning Creek Gold Mining Co., Justice Clement has appointed H. W. Dyson, manager for the Yorkshire & Canadian Trust Co., receiver for the plaintiff and other debenture holders. This probably is the last chapter in some unsavory stock-jobbing, in which C. H. Unverzagt used the Wingdam mine, between here and Quesnel, as a means for raising capital in the United States, despite the fact that Justice Morrison had issued an injunction prohibiting the sale of any of the company's assets. Unverzagt used the curious method of selling gold content in certain areas of the property, averring that it would give a return of 10% per month on the investment.——A. Sanders has suspended work on his lode-gold prospect at Proserpine mountain until next spring.——A. E. Platt, the discoverer of the alluvial gold deposit on a plateau, 500 ft. above Cedar creek, Quesnel lake, is making arrangements to work the property on a large scale next spring. It will require 20 miles of flume to bring water to the property.

Nelson.—R. A. Grimes, president and managing director for the Slocan Silver Mines, Ltd., states that recent development at the company's McAllister mine has demonstrated the existence of one and a half million ounces of silver in the mine. The ore averages 33 oz. silver per ton and about

5% lead. The bottom level has been driven for 600 ft. on the ore-shoot, and the face of the level is still in ore. Another ore-shoot has been cut 400 ft. south of the main ore-body. This shoot has been drifted on for 50 ft., and averages 18 oz. silver per ton. Arrangements are under way for the leasing of a flotation plant at a nearby property, and, in the event of their being successful, a tramway will be built from the mine to the plant. In the meantime, the development of the mine will be continued.——The Roseberry-Surprise Mining Co. has employed 30 extra men at its Bosun mine, at New Denver, and is producing silver-lead and silver-zinc ore, averaging 180 oz. per ton in silver. A considerable tonnage is in the shipping-bins ready to be sent to Trail.

Stewart.—R. L. Clothier has bought a half interest in the Salvator group, up the Marmot river, and will give his attention to the mining of ore from the property this winter. The property is situated on a hill-side, from 800 to 1200 ft. above sea-level, and the ore easily can be rawhided to tide-water, and shipped to Anyox, where favorable arrangements have been made for its smelting, the Granby company requiring silicious ore for fluxing. Two veins are being worked: one is seven feet wide and carries $8 in gold and the other is 18 in. wide and averages $25 per ton in gold.——The Premier Gold Mining Co. is now making regular bi-weekly shipments of precipitate from its cyanide plant.

Victoria.—W. D. Carter, deputy attorney-general, has announced that criminal prosecution against the Britannia Mining & Smelting Co., its manager, and assistant manager is to be commenced at once, in connection with the loss of life in the recent disaster at Britannia Beach. This, of course, is a natural sequence to the finding of the coroner's jury, and undoubtedly such an inquiry would be courted by the company and its managers. An engineer has been employed by the attorney-general to make a thorough investigation.——British Columbia Alluvials, Ltd., with a capital of £70,000 in £1 shares has been organized in London, for the purpose of purchasing and developing placer mines in the Cariboo district.

MEXICO

Cumpas.—R. Quiroga and Jesus Lugo have taken up six pertenencias under the name of El Rocio close to the Cobriza mine west of here. They are developing the property.

Durango.—Jose Bovio, well-known Italian mining man of Chihuahua, has again added a number of new prospects to his holdings in the Villa Hidalgo camp near Inde. He has recorded with the mining agent his application for titles to the Cuahtemoc and Aztec mines, both of which are promising. Some new shafts are to be sunk and cross-cuts run on both of these properties.——Francisco Iturriza, Florian Zarandova, and Jose Escamilla, native miners of the Inde district, are developing La Alianza mine at a point known as the Bufa de Inde. The mine adjoins the Gran Lucero and the Amazon, which produce gold, silver, copper, and lead.——George Stinson, representing El Rosario Mining Co., has located some new properties in the Victoria district west of the station of Santiago Papasquiaro. Stinson has been mining in Mexico for the past 30 years and has developed some rich and productive mines. At present he is extracting some high-grade gold-silver ore.

El Tigre.—The north continuation of the Waldorf vein was recently denounced by E. W. Graves, of Douglas, Arizona. Good showings of telluride ore were opened up by Glennon & Carr on the Waldorf, and float carrying free gold has been found. Considerable prospecting is being done to the north of the Waldorf along the El Tigre range.

Moctezuma.—J. V. Fryer has taken a lease on the Cuernavaca property of Smith & Whitehead. This mine is just south of the Rubi mine in the Rosario district just west of the Zarape claim of the Moctezuma Copper Co. A new shaft is being sunk.

Nacozari.—Lance & Sleiter have patented a large claim near the Tule mine in the Sahuaripa district. A 3-ft. vein of lead ore has been uncovered for some distance along the surface. The ore averages 100 oz. silver per ton. A reverberatory and a cupelling furnace will be installed to smelt the ore.

ONTARIO

Kirkland Lake.—The shareholders of the Teck-Hughes on December 7 approved the proposals to increase the capitalization from $2,500,000 to $4,000,000 and for the sale of the unissued stock at 15c. per share. The money realized will be applied to the payment of outstanding bonds in the hope of reducing the amount of bonded debt to $342,000, which it is proposed to pay from earnings. The ore-reserves, it is stated, amounted to between $900,000 and $1,000,000.

At the Wright-Hargreaves work is progressing on four levels, the gold content of the ore being highest on the 400-ft. level. About 125 tons of ore averaging $12 per ton is being milled daily. The shaft is being put down to the 800-ft. level.

The Comfort-Kirkland has cut a number of narrow veins carrying some gold on the 150-ft. level.

Porcupine.—Some peculiar but rich ore is being taken from the lower levels of the Dome Mines, the material having the appearance of pressed mud with no visible evidence of gold. It is stated to yield from $200 to $300 per ton. Mining men are puzzled to know its composition. Similar occurrences in some of the gold mines of Western Australia suggest the possibility that this material lies at the apex of a deposit of gold tellurides. This view is supported by the finding of limited quantities of tellurides carrying gold in some of the lower workings.

At the Premier Paymaster a cross-cut at the second level has penetrated a body of quartz porphyry about 98 ft. wide containing considerable sulphides. Channel-samples show an average gold content of $5 per ton across the entire ore-body.

It is understood that the projected merger of the North Dome and the West Dome Consolidated is now assured. A new company will be found and a certain amount of stock will be issued to each of the merging companies, sufficient being retained in the treasury to finance development.

The Hollinger Consolidated has established a new high record by the treatment of approximately 4700 tons of ore in 24 hours. This by no means represents the average, but indicates that the average treated during December will be over 4000 tons daily. No official statement as to how the increase was brought about has been issued, but it is understood to be due to finer crushing before the ore was passed through the stamps. The force of the company now numbers about 2200 men.

Should the shareholders of the Porcupine-Vipond-North Thompson, at a meeting to be held December 28, ratify a proposal of the directors to sell 475,000 shares of treasury stock at 15c. per share, it will put the company in a position to finance the sinking of the main shaft from the 600-ft. to the 1000-ft. level, together with some lateral work.

TASMANIA

Hobart.—The Electrolytic Zinc Co. is pushing on rapidly with its program of construction, and it is confidently anticipated that before the end of this year the first big unit of the plant for the production of spelter, using 15,000 hp. of electric current, will be in operation. This will result in an output of about 50 tons of zinc per day. It is officially stated that the company's staff has developed the treatment of Australian zinc-lead-silver ores to a successful economic reality. Tests to decide the best method by which to treat the large deposits of complex ores in Tasmania are still proceeding.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Norman Stines is in New York.

H. H. Webb has returned to Santa Barbara.

Courtenay De Kalb was at El Paso last week.

W. H. Seamon, Jr., of New York, is at Lakeland, Florida.

Edgar Rickard has returned to New York from a visit to Duluth.

Louis W. Whiting, of Mina, Nevada, is at Hyattsville, Maryland.

J. Power Hutchins has been in Morocco recently; he is now in Paris.

A. H. Means, who has been at Pine Knot, California, is at El Paso, Texas.

T. H. Ryan-Jones is with the Dolores Mines Co., at Madera, in Chihuahua, Mexico.

Harry J. Sheafe is examining the Argonaut mine, in Amador county, California.

Ralph H. Jarvis, who has been in the Philippines, has returned to San Francisco.

George H. Garrey, who has been in British Columbia, has returned to Philadelphia.

William Forstner, of San Francisco, has moved to Oak Bar, in Siskiyou, California.

Albert Burch was at Randsburg, California, last week and at Globe, Arizona, this week.

Charles L. Harrington has moved from Grand Junction, Colorado, to Liberty, Missouri.

Ross E. Douglass has moved from Montclair, New Jersey, to Frontera, in Tabasco, Mexico.

Don C. Billick has moved from Alturas, California, to American Flat, Gold Hill, Nevada.

C. B. Lakenan has returned to McGill, Nevada, after spending a week at Salt Lake City.

G. T. Jackson, manager for the Alaska Gastineau Mining Co., at Thane, Alaska, is at Seattle.

E. J. Franklin, mechanical engineer for the Ray Consolidated Copper Co., is at Salt Lake City.

George E. Bent is at South Porcupine for a short time, and will then return to New Preston, Connecticut.

R. B. McGinnis, who has been at Virginia City, Nevada, now has his office in the Mills building, San Francisco.

Walter E. Gaby is visiting Rockport, Texas, but will return to Aire Libre, in Puebla, Mexico, after the holidays.

W. W. Wishon, now of Kingman, Arizona, has been examining the Greenback mine, near Grant's Pass, Oregon.

W. J. McCormick, mine superintendent for the U. S. Graphite Co., at La Colorada, in Sonora, Mexico, is at Los Angeles.

Edwin J. Collins, of Duluth, is engaged in examination work in Cuba and will return home early in January.

H. B. Tooker, traffic manager of the Jackling interests, is at Salt Lake City. He has been spending some weeks in New York.

Clyde Heller, president of the Tonopah Belmont Development Co., reached Philadelphia on his return from Germany on December 18.

Howland Bancroft, who is now at Panama, has been elected a vice-president and director of the Sinclair Panama Oil Corporation.

H. C. George, of the U. S. Bureau of Mines, has returned to San Francisco from an examination of the Eastern and Mid-continental oilfields.

C. E. Chaffin, New York representative of the General Engineering Co., has returned to New York after a six months trip to South America.

George D. Blood, general manager for the Park-Utah Mining Co., has returned to Park City after spending several weeks in southern California.

J. D. Shilling, general superintendent of mines for the Utah Copper Co., spent a few days at Bingham recently. He has returned to National City, California.

H. B. Menardi, recently superintendent for the Nicklas Mining Co., at Battle Mountain, Nevada, is now with the Consolidated Fuel Co., at Denver, Colorado.

Clarence E. Allen, general manager for the U. S. Smelting Co. at Salt Lake City will retire on January 1. He will be succeeded by **D. D. Muir**, manager of mines for the same company.

O. F. Riser, formerly superintendent of mills, and **H. M. Merry**, formerly chief engineer for the Chino Copper Co., Hurley, New Mexico, have opened offices in the Dooly building, at Salt Lake City, as manufacturers' representatives for mining, milling, and industrial equipment and supplies.

Norman Carmichael, who for 15 years has been general manager for the Arizona Copper Co. at Clifton, Arizona, has been retained by the Phelps Dodge Corporation as consulting engineer for the combined properties recently acquired by them in the Clifton-Morenci-Metcalf district, consisting of those formerly operated by the Arizona Copper Co., the Phelps Dodge Corporation, and the Shannon Copper Co. He will move shortly to New York. **J. P. Hodgson**, the present manager for the Phelps Dodge Corporation at Morenci, will remain in the district as local manager of the consolidated properties.

Obituary

Joseph Warner Edwards died on November 7 at Denver, Colorado. He was born in 1852, at Philadelphia, the son of Edward Bird Edwards and Lydia Ford Edwards. He attended the Philadelphia schools from 1858 to 1865 and completed his academic course in Switzerland and Germany from 1865 to 1870. He was an ardent student of rocks from early boyhood and chose geology and mining as his life-work. He was a special student in geology at the University of Pennsylvania in 1873 and 1874, and was an aide to Persifor Frazer in the second Geological Survey of Pennsylvania, from 1874 to 1876. He completed a scientific course at the Royal Saxon Academy of Mines, at Freiberg, from 1876 to 1879, and at Heidelberg in 1880-'81, taking high honors in geology, mineralogy, and allied subjects. He became a member of the American Institute of Mining Engineers in 1876, and was an active member in the early formative days of the Institute. He was also a member of the Academy of Natural Sciences of Philadelphia, the Engineers Club of Philadelphia, the American Association for the Advancement of Science, the Mineralogical Society of America, the Colorado Scientific Society, the National Geographic Society, the Franklin Institute, and others, being always ready to join any group of men in the advancement of scientific research or investigation. For forty years his professional career was woven into the pioneer mining history of Colorado and the West. He was a man of high culture, keen analytical mind, and gracious personality. His fine attainments as an accomplished and upright scientist, his genial character, and his loyal friendship are a heritage and an influence that will live long in the memory of his many friends and associates. He belongs to that early group of scientists whose aspirations and labors have done so much to formulate and advance the practice of the profession of mining engineering and to maintain its high ethical standards.—W. D.

Stephen Donaldson, mine captain at the Kirkland Lake mine, was killed in a blasting accident in the mine on December 12. He was 34 years of age, and leaves a widow and three children.

THE METAL MARKET

METAL PRICES

San Francisco, December 20

Aluminum-dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6.25— 8.25
Copper, electrolytic, cents per pound	14.75—15.25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$78
Platinum, 10% iridium, per ounce	$90
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10.00

EASTERN METAL MARKET

(By wire from New York)

December 19.—Copper is quiet and stronger. Lead is quiet and steady. Zinc is quiet and higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Dec. 13	65.50	34.87	Nov. 7	69.46	39.93
" 14	66.25	35.75	" 14	67.28	38.85
" 15	65.37	35.12	" 21	68.54	38.53
" 16	65.62	35.62	" 28	67.55	37.85
" 17	67.00	36.37	Dec. 5	67.27	37.35
" 18 Sunday			" 12	65.46	35.44
" 19	66.75	35.87	" 19	66.08	35.60

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	101.12	132.77	65.95	July	106.36	92.04	59.99
Feb.	101.12	131.27	59.55	Aug.	111.35	96.23	61.59
Mch.	101.12	125.70	56.08	Sept.	113.92	93.66	66.22
Apr.	101.12	119.56	59.33	Oct.	119.10	83.48	71.00
May	107.23	102.69	59.90	Nov.	127.57	77.73	68.24
June	110.50	90.84	58.51	Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date		Average week ending	
Dec. 13	13.50	Nov. 7	12.75
" 14	13.50	" 14	12.88
" 15	13.62	" 21	13.19
" 16	13.62	" 28	13.35
" 17	13.62	Dec. 5	13.39
" 18 Sunday		" 12	13.46
" 19	13.62	" 19	13.58

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	20.43	19.25	12.94	July	20.82	19.00	12.46
Feb.	17.34	19.05	12.84	Aug.	22.51	19.00	11.71
Mch.	15.05	18.49	12.20	Sept.	22.10	18.75	12.03
Apr.	15.23	19.23	12.50	Oct.	21.66	16.53	12.66
May	15.91	19.05	12.74	Nov.	20.45	14.63	13.07
June	17.53	19.00	12.83	Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Dec. 13	4.70	Nov. 7	4.70
" 14	4.70	" 14	4.70
" 15	4.70	" 21	4.70
" 16	4.70	" 28	4.70
" 17	4.70	Dec. 5	4.70
" 18 Sunday		" 12	4.70
" 19	4.70	" 19	4.70

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	5.60	8.65	4.96	July	5.53	8.63	4.75
Feb.	5.13	8.88	4.54	Aug.	5.78	9.03	4.40
Mch.	5.24	9.22	4.06	Sept.	6.02	8.08	4.61
Apr.	5.05	8.78	4.32	Oct.	6.40	7.28	4.70
May	5.04	8.55	5.01	Nov.	6.76	6.37	4.70
June	5.32	8.43	4.57	Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	71.50	62.74	35.94	July	70.11	49.29	27.69
Feb.	72.44	59.87	32.16	Aug.	62.20	47.60	26.35
Mch.	72.50	61.92	28.87	Sept.	55.79	44.43	26.70
Apr.	72.50	62.17	30.36	Oct.	54.82	40.47	27.70
May	72.50	54.99	32.50	Nov.	54.17	36.97	28.93
June	71.83	48.33	29.39	Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Dec. 13	5.17	Nov. 7	5.18
" 14	5.17	" 14	5.23
" 15	5.20	" 21	5.18
" 16	5.20	" 28	5.14
" 17	5.20	Dec. 5	5.23
" 18 Sunday		" 12	5.31
" 19	5.22	" 19	5.19

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	7.44	9.56	5.86	July	7.78	8.18	4.41
Feb.	6.71	9.15	5.34	Aug.	7.81	8.31	4.69
Mch.	6.53	8.93	5.19	Sept.	7.57	7.84	4.74
Apr.	6.49	8.76	5.33	Oct.	7.82	7.50	5 09
May	6.43	8.07	5.37	Nov.	8.12	6.78	5.18
June	6.91	7.92	4.96	Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Dec.	
Nov. 22	40.00	" 6	46.00
" 29	40.00	" 13	52.00
		" 20	52.00

Monthly averages

	1919	1920	1921		1919	1920	1921
Jan.	103.75	89.00	50.00	July	100.00	88.00	47.75
Feb.	90.00	81.00	48.75	Aug.	103.00	85.00	47.50
Mch.	72.80	87.00	45.88	Sept.	102.60	75.00	47.50
Apr.	73.12	100.00	46.00	Oct.	86.00	71.00	46.25
May	84.80	87.00	50.00	Nov.	78.00	56.00	40.40
June	94.40	85.00	49.50	Dec.	95.00	52.50	....

THE BUDGET

The 'Commercial & Financial Chronicle', commenting on the national budget, says:

"Heretofore, according to Director Dawes, the business administration of our Government has 'labored' (the word is well chosen, and the laboring has been unconsciously shared by the people who bore the burden) under difficulties like those of a private corporation which he imagines for purposes of illustration. This imagined corporation had a president who gave no attention to its ordinary routine, avoiding all responsibility for the proper conduct of its affairs and neither assumed nor delegated active control. Not to be outdone, the administrative vice-presidents were allowed to run their several departments 'without any enforced contact in the discussion of routine business matters of the corporation and as if each separate department was an independent authority in all matters of routine business'. Third, because of the situation outlined in points 1 and 2, 'the several departments operated with almost an entire lack of co-ordination'. No unified system for buying needed material, or selling any surplus existed; a department requiring material never looked or thought of looking to see whether there might be an available surplus in possession of another, but went out into the open market.

"Mr. Dawes adds eight more 'difficulties', which must be condensed for the sake of space. The corporation had not the safety check of being operated for profit, and its funds were obtained by 'a levy upon stockholders, per a Congressional appropriation collected through taxes'. There was never a balance-sheet, or an inventory of material and supplies, or a statement of current assets, or even a known way of getting any. When each department was notified of the credit allotted to it, the same absence of definiteness caused outlays to overrun the credit and produce deficits to be afterward taken care of.

"Naturally, the 'corporation' never reconsidered any unwise project taken up by any department; each department felt custom-bound to spend all it could get and incur obligations for something more, and this feeling 'of independence of an executive control, owing to its complete lack of exercise', became so firmly embedded in the minds and the affections of the department heads that conferences looking toward correction of evils growing out of the lack of co-ordination were apparently avoided, 'lest out of that contact information should develop which might stimulate the head of the corporation to an invasion of the independent control of the departments'.

"The administrative department heads were chosen, as a rule, with less reference to their business qualifications 'than to their qualifications as advisers to the president of the corporation along other lines than routine business'. Their tenure was often less than four years, so that they had not time to learn and they never felt responsibility. The subordinate members of departmental organizations 'were encouraged to state the needs of their particular subdivision of their department directly to the agency of the corporation (Congress), which made the desired levy on the stockholders (the public). Finally, the natural tendency in making schedules of expenditure was 'to consider their relation to popular approval, whether right or wrong', thus often putting a premium on expenditure instead of on saving."

MONEY AND EXCHANGE

Foreign quotations on December 20 are as follows:

Sterling, dollars:	Cable	4.22
	Demand	4.22½
Franc, cents:	Cable	8.18
	Demand	8.20
Lira, cents:	Demand	4.62
Mark, cent:		0.61

Eastern Metal Market

New York, December 14.

Continued strength features nearly all the markets—strength in prices as well as in demand.

The demand for copper continues active and the lower prices are disappearing.

Tin has advanced sharply, due principally to the spectacular rise in exchange on London and to a higher market there.

The lead market is featured by steady buying at firm prices.

Demand for zinc is still light for early delivery, but prices have not receded except in so far as the new freight differential has affected them.

Antimony is quiet and unchanged.

IRON AND STEEL

In both pig-iron and finished-steel markets the near approach of the year-end is evident in two respects. Producers have been more disposed to make concessions to improve their cash position and consumers have limited their buying so that inventory might be brought down to a low point. These influences have created fresh uncertainties as to the prices at which the larger business looked for in the new year will be done, says 'The Iron Age'.

The belief is widespread in the trade that reductions in freight-rates will come early in the new year and that the decision by the Commerce Commission to restore the higher iron-ore rates on January 1 does not mean opposition to a reasonable reduction.

November steel-ingot production showed a slight gain and 20,000,000 tons may be the 1921 total, compared with nearly 41,000,000 tons in 1920.

COPPER

A rather unexpected development is the large demand for early shipment, consumers' needs being evidently heavier than was looked for. Inquiry and business for first quarter continue brisk for domestic consumption, and foreign demand has not abated. The price tendency is firmer, but continues to vary with the ideas of the seller. The chief development is the gradual disappearance of the minimum level for early delivery of 13.50c., refinery or New York, and 13.75c., delivered. Not much more metal can be bought at this price. For January and first quarter 13.75c., refinery, or 14c., delivered, is the minimum. The market is tending toward a 14c., delivered basis. In November deliveries into consumption were probably larger than in any month this year and it is acknowledged that stocks are smaller by a liberal margin.

TIN

As to sales the week has generally been quiet. A moderate business, light in volume, has been done and some fairly good orders have been placed, but there has been nothing like the heavy buying of last week and three weeks ago. The feature is the brisk rise in the pound sterling, which has affected the value of tin here and in London. Spot Straits tin, New York, yesterday was quoted at 32.75c. against 33.50c. on Monday and 31.75c. a week ago. There was a reaction in exchange yesterday from Monday. In London prices yesterday were about £2 per ton higher than a week ago at £169 15s. for spot standard, £171 10s. for future standard, and £170 7s. 6d. for spot Straits. The rapid advance late last week and Monday in exchange put a decided damper on buying. The course of the market the rest of the month is expected to develop, in the opinion of a large importer, a shortage with a consequent premium on spot tin, should any demand develop. Some think December deliveries will be large and stocks small on January 1 because consumers have been heavy buyers recently, there being probably enough tin on the way to meet spot and nearby needs. Arrivals thus far this month have been 1695 tons with 4740 tons reported afloat.

LEAD

Demand continues steady and prices are firm. There is no reason for any spurt in this market as consumption and production are quite evenly balanced. The leading interest continues to quote 4.70c., New York and St. Louis, at which it is still taking business. Independent producers are asking 4.75c., New York, and 4.40c., St. Louis. The London market is higher, and the rise in exchange has also affected prices so that the American equivalent is about 4.85c. per pound.

ZINC

The market continues quiet and featureless. There is a light demand for early shipment to fill hand-to-mouth needs of some consumers. Inquiry for first quarter is more active. The new freight-rate on prime Western from St. Louis to Eastern points went into effect on December 12 and is now 35c. per 100 lb. instead of 50c. This therefore makes a spread of 35 points between St. Louis and New York instead of 50 points. Prime Western for early delivery is quoted at 4.85c., St. Louis, or 5.20c., New York, with first quarter at five points each month above this level. For first quarter as a whole the quotation is 4.95 to 5c., St. Louis.

ANTIMONY

Conditions are without change. Wholesale lots for early delivery are quoted at 4.50c. per pound, New York, duty paid, with prompt metal at 4.55 cents.

ALUMINUM

Virgin metal, 98 to 99% pure, in wholesale lots for early delivery, is quoted by the leading interest at 19c. per pound f.o.b. plant. The foreign metal of the same grade is quoted by importers at 17 to 18c. per pound, New York, duty paid.

ORES

Tungsten: The market continues without feature. Prices are nominal at $2 per unit and upward, depending on the grade of ore, the quantity, and delivery.

Molybdenum: Quotations continue nominal at 45 to 50c. per pound of MoS_2 in regular concentrates.

Manganese: The absence of interest in the market is pronounced and quotations are nominal at 20c. per unit, Atlantic seaboard.

Chrome: Large supplies still hang over the market and quotations are nominal at $20 to $28 per net ton, c.i.f. Atlantic ports, depending on grade and other circumstances.

FERRO-ALLOYS

Ferro-manganese: The fairly large inquiries before the market a week ago have not been absorbed. Quotations are unchanged at a basis of $58.35 for both British and American alloy, excepting that sold by the Steel Corporation at $60, Pittsburgh. A higher price for British is declared possible if exchange continues to advance.

Spiegeleisen: Sales of a few carloads are reported at $26, furnace, for the 20% grade, otherwise the market is quiet.

Ferro-tungsten: Prices continue nominal at 40 to 45c. per pound of contained tungsten for the domestic alloy with 50c. asked for the imported at the seaboard.

Ferro-silicon: There is no demand for 50% ferro-silicon and the market is nominal at $60, delivered. The price of the leading American maker is $85.

Ferro-chromium: Standard American alloy, 60 to 70% chromium and 4 to 8% carbon is quoted at a minimum of 14c. per pound delivered. Imported alloy is available as low as 11 cents.

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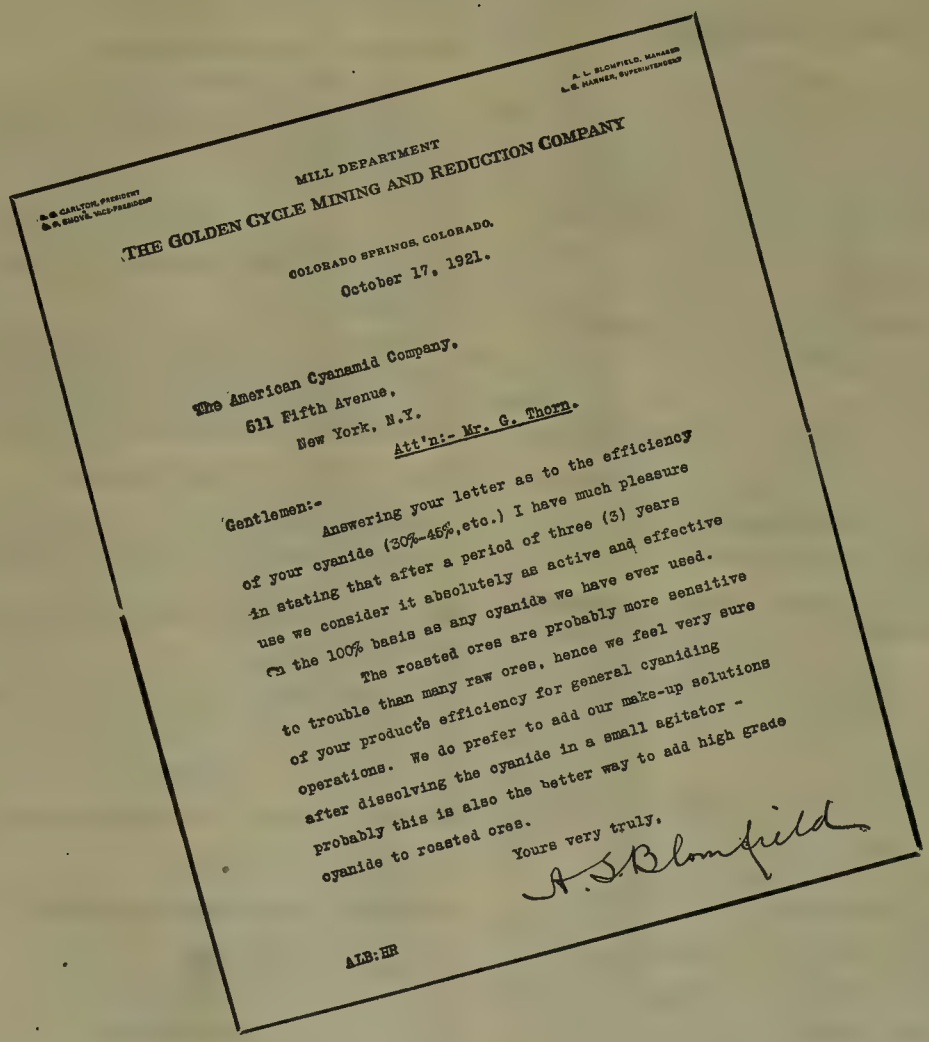
AERO BRAND CYANIDE



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MILL DEPARTMENT

THE GOLDEN CYCLE MINING AND REDUCTION COMPANY

COLORADO SPRINGS, COLORADO,
October 17, 1921.

The American Cyanamid Company,
511 Fifth Avenue,
New York, N.Y.
Att'n:- Mr. G. Thorn.

Gentlemen:-

Answering your letter as to the efficiency of your cyanide (30%-46%,etc.) I have much pleasure in stating that after a period of three (3) years use we consider it absolutely as active and effective on the 100% basis as any cyanide we have ever used.

The roasted ores are probably more sensitive to trouble than many raw ores, hence we feel very sure of your product's efficiency for general cyaniding operations. We do prefer to add our make-up solutions after dissolving the cyanide in a small agitator - probably this is also the better way to add high grade cyanide to roasted ores.

Yours very truly,
A. L. Blomfield

ALB:HR

AMERICAN CYANAMID COMPANY

511 FIFTH AVENUE, NEW YORK

T. A. RICKARD, ... Editor

STATISTICIANS aver that warehouse stocks of automobile tires now total 3,500,000 as against 10,000,000 a year ago. Among others who are pleased with this information are the producers of zinc; renewed activity on the part of tire manufacturers means increased demand for zinc oxide, for at the present time half of the zinc output of the country is being absorbed by the tire fabricators, as compared with about a quarter in former years. Improvement has been reflected in the price for the metal and production has increased materially; rumors are heard that the Butte & Superior company is to resume operations at once.

DISCUSSION this week starts with an informing letter from Mr. Lucien Eaton, who gives further data on the use of scrapers underground, in sequel to his valuable article on that subject. Three contributors supplement and correct our recent editorial on the newly prominent mining district of Royston, or San Antone, in Nevada. We thank them for the information they give. Mr. C. Flury writes from Korea on the regeneration of cyanide, a highly technical matter to which reference was made in an earlier article by Mr. Algernon Del Mar. The controversy between Mr. Leon Perret and sundry American mining engineers, on the methods of placer mining in use in Russia, is clarified somewhat by a letter from Mr. W. E. Thorne, who has been on the ground and is familiar with the facts. Our friend Mr. Thomas T. Read discusses the letter from Mr. S. H. Dolbear on 'Wetting and Amalgamation', appearing in our issue of November 12. His own earlier researches in amalgamation enable him to suggest several interesting likenesses and differences in the two physical processes. The last letter under 'Discussion' is from Mr. Warren D. Smith, who writes from Manila on the proposed revision of the mining law. He draws upon his knowledge of conditions in the Philippines and emphasizes the fact that there, as in the United States, the development of mineral resources is checked by the passing of the land into the hands of those unwilling or unable to explore or exploit.

THE collapse of Silver Hills as a mining enterprise is chiefly of local interest, but it has phases that are worthy of comment. The mine is in Nevada, it was commended by a reputable engineer, and looked promising. Unfortunately what good features it had were exaggerated for the purpose of boosting the shares on the San Francisco Stock Exchange, which has an unsavory name. The shares rose from 8 cents to 66 cents, largely, it is alleged by the Commissioner of Corporations, because of cross-sales, whereby a fictitious price was created. The broker held responsible for this performance, Mr. Don C. Aldridge, has announced his intention of bringing suit for damages against the Commissioner. We hope he will, for the ventilation of the matter in court would test the power given to the Commissioner of Corporations by the law designed to check the queer practices of the local exchange. Unfortunately at this juncture it is announced that Mr. E. C. Bellows, the Commissioner, is to resign from office to accept a highly remunerative appointment as president of an important financial institution. We hope he may receive at least half of the gorgeous salary mentioned in the daily press; but, even if it fall far short of that, the transfer of his energies from public to private business exemplifies again the fact that an honorable tenure of office under the State is used by many, properly enough, as a means of personal preferment, and that under our system of political appointments it is impossible for the State to retain a good man for long. Our own impression is that Mr. Bellows has discharged the duties of Commissioner of Corporations with fairness and sincerity for the benefit of legitimate industry in California; so we wish him well in his new departure. As for Mr. Aldridge, this is not the first mining-share fiasco in which he has figured, and we feel strongly that it will be well for mining if less delving into pockets is done on Bush street and more digging into the ground at the mines. Mr. Aldridge received on his own account one share for every share that he sold to the public; he is cruel to some of the victims of his own stock-jobbing activities when he asserts that "the cupidity of some of the speculators got the best of them and caused them to buy more than they could pay for, the brokers carrying the stock for them on loan accounts". We suppose that this result was in accord with the purpose of a share-boosting campaign. After the collapse, it appears that Mr. Aldridge proposed to increase the capital of the company by 500,000 shares, and to take an option on these shares at 8 cents apiece, with a view to financing a new start on fresh property in Arizona. He says: "I had hoped that I would be able to make a second profit for the shareholders, but I do not propose to be criticized by the

Commissioner of Corporations". Whether the shareholders desire a "second profit", just like the first one, we do not know, but it seems to us that the Commissioner is warranted in criticizing Mr. Aldridge and his kind.

UNBIASED testimony is always valuable and often interesting. Mr. Fernando Benitez in his concluding article in this issue, on the operations at Catemu, Chile, deals at length with labor conditions in that country. He pays a well-deserved tribute to the sterling qualities of the Chilean, who on the average is a hard worker, a mechanical genius, and an obedient and law-abiding employee; to his friend he is generous to a fault; to those who would drive him at his task he is soon dissatisfied and sullen, sometimes openly aggressive. Mr. Benitez draws attention to the conditions under which the average Chilean laborer lives, likening his habitation to a pig-sty, in which sanitation is conspicuous by its absence. It is therefore with a great deal of gratification that we note the tribute that he pays to the large American corporations for the success that has been achieved by them in welfare work in Chile. We agree that Chileans appreciate the advantages and improvements that are evident at an industrial centre such as Chuquicamata; and it is hoped, as Mr. Benitez says, that other mining and industrial concerns will copy the splendid lead that has been given by American operators. A frank statement such as this has been needed for some time, if only to counteract the insidious propaganda of misrepresentation, in regard to the attitude of American corporations toward Chilean employees, that appears to pass unchallenged. As an example of this we have before us a book published recently in Santiago entitled 'Chuquicamata, su Grandeza y sus Dolores' ('Chuquicamata, its Glory and its Griefs'). The cover, in brilliant colors, depicts a small boat-load of cowering and frightened Chileans, one of whom is preparing to jump overboard to escape the horrors that appear to be imminent. Standing above these cringing unfortunates towers what our South American friends would term a Norte-Americano, who is identified by a waist-belt ornamented with the Stars and Stripes. This individual, of giant stature, bloodthirsty appearance, and menacing attitude, is flourishing an oar toward the group of terrified Chilenos who are huddled, helpless and dismayed, at the other end of the boat. It is lamentable that such an absurdity as this should receive the sanction of publication by the Chilean authorities. The implications insinuated by the title and the illustration on the front page, as well as the derogatory reference to American enterprise in Chile in the book itself, are so stupid and so absurd as to appear ludicrous to anyone who knows Chile and who has taken the trouble to learn the facts of the case. The misunderstandings that arise and the trouble that is fomented by the publication of such despicable misinterpretations of conditions can only be removed by permitting the fullest publicity; and this attitude, we are glad to say, has characterized the policy of the Chile Exploration Company since the inception of its operations.

Anaconda Copper and American Brass

The absorption of the American Brass Company by the Anaconda Copper company seems to be assured, although the final decision rests with the stockholders of the former company, who under the terms of the present offer may exchange their stock on the basis of $150 cash and three shares of Anaconda for each share of American Brass, provided 51% of the stock outstanding be offered. Anaconda's shares are selling at about $50, thereby placing a valuation of $45,000,000 on the capital stock of the other company, shares in which have recently advanced to $300 from $165, doubtless in anticipation of the proposed merger. In 1918 the American Brass Company fabricated 600,000,000 pounds of metal from its five extensive plants; it is now the largest single consumer of copper in the United States, and in recent years has done about 40% of the brass manufacturing of the country. In normal times the Anaconda company produces from its mines at Butte less than 300,000,000 pounds of copper per year; so it is apparent that the merger, if consummated, will provide amply for the disposal of whatever copper is left after the demands of the company's rod- and wire-mills at Great Falls are satisfied. Account must necessarily be taken of the large production of zinc from the mines at Butte, and of the copper that will be produced by the subsidiary companies in South America. The large steel corporations control companies that produce the raw materials, including both ore and fuel; companies that smelt the ore, others that convert the iron into steel, others that roll the ingots and fabricate the shapes; and finally those that distribute the finished product and sell it to the consumer. In this unification of control is supposed to lie much of their strength, and it seems evident that the Anaconda company has in view a similar organization of its operations. One of the peculiar conditions that has obtained in the copper industry has been the wide 'spread' between the market price of refined copper and the cost to the user of manufactured copper products. Numerous explanations for this have been advanced, but no entirely convincing figures have been offered to show that somewhere between the producer and the consumer there has not been unwarranted profit, or unnecessary waste in methods of manufacturing and marketing. The inevitable result was restriction in the use of copper products. The interest of the Anaconda company obviously lies more in stimulating the consumption of copper in order to increase the demand for raw material and to afford an outlet for the product of its mines, than in making profits on manufactured articles. It seems reasonable that co-ordinated administration of all branches of the industry will permit more efficient manufacturing and selling by the Anaconda company, to the end that the consumer as well as the producer may profit. The result should be that other manufacturers, to survive, must conduct their business more economically, and in the end not only the copper mines but the zinc mines throughout the country will share the benefit.

America's Oil Supply

A plea for the unification of American oil enterprises that are operating in foreign countries is made by Mr. L. G. Huntley, of Messrs. Johnson, Huntley & Somers of Pittsburgh and Dallas, who contends that the random operations of such concerns are seriously handicapped by many disadvantages. These include limited capital; insufficient and inexperienced organization for foreign work; secrecy, as a result of competition; local jealousy of foreign governments, encouraged by the fact that rival interests are often competing for concessions at the same time; lack of consular and diplomatic assistance; difficulty in obtaining protection from the operation of unfavorable and retroactive laws, passed after development has reached a favorable stage, which take the form of stringent labor regulations, unreasonable export and production taxes, and arbitrary royalty charges; lack of military and civil protection in some countries; insufficient knowledge of local laws and customs, and of title requirements; absence of financial connection with established banks in foreign countries; and departmental indifference or active antagonism at Washington.

It is maintained that in foreign fields the duties of acquiring land, of developing production, of building roads, pipe-lines, terminals, railways, and floating equipment may devolve on the foreign manager, who, in addition, is required to attend to a considerable amount of political and legal work. This is not conducive to efficient operation. Furthermore, the capital needed is invariably considerable, and only a few of the stronger groups in the American oil industry can take the risk that is involved in bearing the preliminary expense. Thus it is that the smaller operators become discouraged before achieving their purpose; or, when drilling operations have been successful, they may sell to stronger groups, not always at a profit. Few of the companies operating in the domestic oil-fields have had sufficient experience in foreign countries to have built up a personnel that is efficient for the work; the majority of their employees are unwilling to go abroad or incapable of taking charge of operations away from home, although these may be similar, technically considered, to those in which they may have had much experience in the United States. This is not surprising, for ignorance of a foreign language, of local customs, of climatic conditions, and of the labor that is available in foreign countries constitute obstacles that few men of middle age care to take the trouble to overcome. We agree with the contention that a certain virile type of mentality and outlook is necessary for successful work abroad, coupled with a breadth of view and an absence of insularity. The capabilities of the engineer engaged must include resourcefulness and an ability to use materials and to adopt methods that are available, regardless of past experience, rather than to wait for the arrival of shipments that may be delayed and for skilled labor from the United States. Many men are so accustomed to calling up a supply-house on the telephone, and requisitioning material in routine manner, that they are helpless when such facilities are unavailable. If an employee be discharged from the ranks of an oil company operating in the United States, he can be replaced usually almost immediately by another who is equally as efficient. When a similar need for dismissal occurs in a foreign country it may be weeks or months before the employee can be replaced; meanwhile important work is delayed, unless the manager be a resourceful man.

Being accustomed to playing a lone hand in the domestic oil-fields, says Mr. Huntley, some companies have adopted similar methods abroad; but the average Spanish-American is disposed to be suspicious of foreigners; therefore such secrecy encourages conclusions that are unwarranted. Competing interests, particularly those of nationals other than North Americans, as they call us in South America, sometimes take advantage of this suspicion to inculcate mistaken ideas in the minds of the natives, to the embarrassment of American companies, each of which may be instigating political intrigues in order to get concessions. Inter-company friction is detrimental to such enterprises. It is maintained that Americans have learned to avoid their consulates and legations when they need assistance; an instance is quoted in which the U. S. Minister to a foreign country failed to lend such assistance because he was backing the activities of several irresponsible promoters who were preying on the resources of their more solid competitor by attacking his title. This, of course, is deplorable. Small companies apparently cannot claim assistance from governmental sources without the suspicion that favors are being sought and discrimination invited.

Ignorance of local laws and customs also constitutes a factor that is unfavorable to efficient and successful operations abroad. Small companies that desire to enter the foreign field are handicapped by a lack of knowledge concerning the conditions under which oil-lands may be acquired or leased; they may accept a defective title to concessions or to land that is owned privately. Unavoidable duplication of such grants often occurs, to the enrichment of a type of lawyer that is only too common. It is maintained that the title to oil-lands in all the countries of Central and South America is invariably unsound, and that the defects usually are not discovered until the land has become valuable as the result of exploitation. The small development company may find that it has spent a great deal of money in exploring land to which it has no good title; or at least upon which there is enough defect to throw the whole affair into the courts for years, until a substantial blackmail has been collected, either by the parties attacking the title, or by the courts, or by both. A large corporation would be relatively immune from such annoyances.

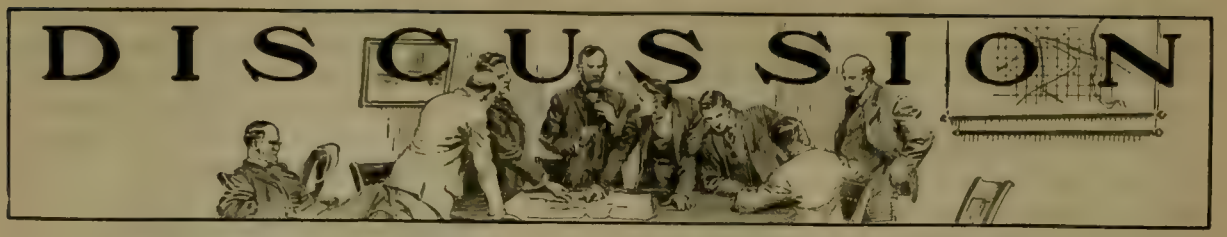
Excessive taxation on the part of foreign governments has been the ruin of many American enterprises abroad. Mr. Huntley emphasizes the fact that politicians are notoriously shortsighted and are usually governed by selfish aims. We are inclined to agree that the tropical variety is sometimes particularly unscrupulous; in the

absence of an intelligent public opinion their actions often take the form of harrying foreign corporations for monetary gain. Industries that were backed by American capital have been started at various times in such countries; some had reached, not without an unusual display of courage and skill and initiative, the stage when a reasonable profit seemed assured; then came excessive taxation and governmental legislation of various kinds, which was designed to squeeze all available profits for the pecuniary benefit of the clique that controlled the government at the time. It is maintained, strange as it may seem, that the adoption of such a policy of ignorance and shortsightedness is on the increase. The result of recent tax decrees in Mexico is such that it will be impossible to maintain further development work in the less prolific oil-fields; the cost of production and the high rate of amortization of pipe-lines and other equipment will make such development economically impracticable.

Mr. Huntley affirms, and with logic, that although we produce sufficient oil within the United States at the present time for our own needs, we must look ahead, so that when our present resources are exhausted or depleted we may still be able to maintain a position of security in regard to future supplies from those parts of the world in which oil-lands have been developed in consequence of the initiative and capital of American companies. It is proposed that a syndicate or corporation be formed, comprising the principal oil groups, most of whom are engaged already in preliminary operations in foreign fields, to meet every requirement of the business in those countries in which it decides to operate. The syndicate would absorb the foreign operations of its members, issuing stock or shares to each on the basis of the value of holdings, as decided by a committee of appraisers. It is mentioned, however, that the principal independent groups in the American oil industry have been built up and are controlled by men of unusual initiative, and these possibly would object to a co-operation that might lead to the submerging of individual identity, foresight, and energy. An alternative plan is therefore proposed by which the syndicate would act merely in a financial and protective capacity, for which it would be entitled to an option on a portion of the oil produced. In such case the syndicate might operate its own tankers, and pro-rate the oil among the refineries of its members. It is claimed that the formation of such a syndicate would encourage individual initiative by providing capital at reasonable terms and by furnishing transportation, at a fair price, for oil produced by American companies operating in foreign countries; it would lessen competitive jealousy and would strengthen the influence of American oil companies in foreign capitals; it would furnish readily accessible information on laws, customs, operating conditions, costs, and general data of interest to companies operating abroad; it would ensure a measure of protection against confiscatory decrees and unreasonable taxation, and in general would ensure a large measure of political protection; and, finally, it would stimulate co-operation at Washington, without which, it is claimed, American enterprise must abandon, once and for all, any hope of successful operation in foreign fields; for without this it will be the prey of every self-seeking politician in the country in which it is operating. As a trading and manufacturing nation our self-preservation demands that the sources of an essential raw material such as oil be controlled adequately, especially when developed by American energy and American capital.

Platinum

In our last issue we made some comment on the purported discovery of platinum ore near Winnemucca, Nevada. One chemist found platinum in numerous samples, whereas others found none in samples from the same source. The first man insisted that the metal was present, and inferred that the other analysts did not know enough to detect it. Without implying any reflection upon the first chemist, it may be said that a few years ago, when the high price of platinum stimulated prospecting for it, sundry ignorant or dishonest assayers in the Western States made a practice of reporting platinum in rocks that subsequent investigation proved to be barren, for practical purposes at least. The revenue from making assays at $2 each apparently induced strenuous effort to 'detect' the metal and thereby encourage dozens of new prospectors to bring hundreds of new samples. Fifty samples per day meant $100 per day. When the results were not confirmed by assayers of wide experience and established reputation, the man who had made the encouraging assay resorted to the claim that the particular kind of platinum present in the ore could be detected only by a 'special' method, the details of which, for obvious reasons, he did not care to disclose. The implication was that the 'big city' chemist did not know his business. Unfortunately the text-books on methods of ore analysis did not detail any complete and specific method for making assays for platinum, and this fact lent color to the claims of the possessors of alleged secret methods. The established chemists knew exactly what they were doing and were sure of their ground, but this absence of clear instructions and procedure, authenticated by the subtle power of publication in print, enabled the unscrupulous assayer to envelop in a cloud of mystery the whole matter of testing ores for platinum. The sufferers were the prospectors, who were led to devote their time to a search that was almost sure to be fruitless and to spend money on assays that were worse than worthless. This was one of the considerations that led to the preparation of Technical Paper 270, by C. W. Davis of the U. S. Bureau of Mines. Besides a quantity of exceedingly interesting information, this pamphlet gives a selected method for making an analysis of a sample of ore, detailing each operation so that any intelligent assayer can do the work. As the author says, the scheme contains nothing new; but it does put the facts in black and white. We venture the opinion that there is much more likelihood of an assayer 'finding' platinum in an ore that contains none than of his failing to find it in an ore that does contain an appreciable quantity.



Use of Scrapers Underground

The Editor:

Sir—In your issue of December 3, Mr. C. F. Jackson, in commenting on my recent article on the use of scrapers underground, gave a brief description of the Evans scraper loading system, as used successfully by the Hudson Coal Co., and called attention to Mr. H. D. Kyner's paper on 'Mechanical Methods of Mining Anthracite', presented at the Wilkes-Barre meeting of the American Institute of Mining and Metallurgical Engineers last September. Although I have never seen this system in operation, I have read descriptions of it in the article on loading machines by Mr. A. M. Gow, published in the 'Engineering and Mining Journal', Vol. 109, No. 5, p. 319, and in the catalogue of the Goodman Mfg. Co., as well as in Mr. Kyner's paper. The Evans system is also described by Mr. Ward Royce in an article published in the 'Engineering and Mining Journal' of December 10, 1921. I referred to it in an article in the 'Compressed Air Magazine', published in May 1921.

The equipment used with the Evans system is too heavy to be taken up and down raises, in mines where the ores is mined by top-slicing methods, and it requires a crew of four or five men. On our sub-levels, in order to get the best results, the scrapers must be run by the miners themselves, without outside help, and this limits the crew to two men. By using a snatch-block and roller, as in the Evans system, we could pull a scraper around a right-angle turn, but it would require an extra man at the turn, or at least take away the man who now works in the breast, thereby slowing up the loading operation. It is possible to get around a right angle with the scraper by making two 45° turns close together, but this complicates the timbering. I am at present studying this problem, and hope to work out an arrangement by which the turn can be successfully made without increasing the number of men.

I agree heartily with Mr. Jackson in his regret at the lack of interchange of ideas between coal and metal miners, and have felt for some time that at the sessions of the American Institute the division of the members along these lines is a mistake. After the ore or coal is broken, the business of mining resolves itself very largely into a problem of transportation, the solution of which often determines the success or failure of the enterprise.

Referring again to my article in your issue of November 19, I made the statement, on page 707, that "the main disadvantage is that in drifting no drilling can be done while the scraper is in use". I have since received a letter from Mr. Charles L. Lawton, general manager for the Quincy Mining Co. at Hancock, Michigan, in which he says: "At no time in our experience with drift scrapers has their use interfered with drilling or blasting. The drilling goes forward the same as though the scraper and incline were not installed or in operation". This is welcome news, and I am glad of the correction. I have never seen drilling done while the scraper was in use in a drift, and have never attempted it.

LUCIEN EATON.

Ishpeming, December 13.

Royston

The Editor:

Sir—The editorial about the new camp of Royston, in your issue of December 10, is interesting and instructive. At one point it seems to carry a great lesson. You say, referring to Charlie Poy, the Chinaman, and his negotiations for the purchase of a quarter interest in the Betts lease: "who went himself to see the ground and to judge of its promise as a mine".

This shows that we Americans have much to learn from the Chinese. Most of us would have hired (what is the proper word: retained or hired?) a mining engineer to look at the lease for us, and have given him $150 for his unfavorable opinion. I have little doubt that several unfavorable opinions by engineers might have been obtained in Tonopah without even going to the trouble of making an examination.

The cold fact of the matter is that the great majority of mining engineers are absolutely unqualified to determine the value of a prospect. They turn 'em down simply as a matter of principle. It seems to be a source of constant wonder to you that prospectors do not love the engineering profession. The only wonder to me is that the average prospector will allow an engineer to step on his ground.

E. C. WATSON.

Luning, Nevada, December 13.

The Editor:

Sir—The mention of San Antone in your issue of December 10 recalls the fact that it was one of the early centres of prospecting in the State of Nevada. When Governor Blaisdell's exploration party of 1866 was homeward bound we had been fortunate enough to get into touch with Indians, and when in the vicinity of what is now Tonopah our guide for the day told us that "White men were fighting rock", pointing to the north.

A former Indian agent had joined us at Hiko and acted as interpreter. As white men and civilization were just what we wanted above all things by that time, we naturally took the hint and found that at some prior date prospectors had dug holes all over the region and apparently abandoned it. Feeling that we had earned a rest, and that our troubles were over, we made camp. Wandering from pit to pit it struck me as peculiar that while many of them showed ore there was none of it lying around the openings. I finally came across a good-sized dump, much bigger than could have come out of the adjacent hole, and discovered that someone had patiently collected all the visible supply of ore in the neighborhood to enhance the value of his own location in the eyes of a promoter. While engaged in sorting the pile to see how many types the owner thought permissible for a tenderfoot, the lone inhabitant turned up, and strenuously, in language impolite, wanted to know why I was monkeying with his property. He learned that his scheme might prove a boomerang as suggesting a want of honesty on his part, and we parted good friends. In later days he probably made a good promoter. The Chinaman is not alone in tricks that are strange!

I do not recall that we had any trouble on the water question. The Indians apparently seldom knew the water-holes more than a day's journey ahead, but as we generally got a new guide daily, they always took us to water. They were inconceivably low in the scale of humanity, many of them clad in nature's scant attire, with lizards and wild vegetables for food, small bows for weapons, and fire a most precious possession. Many had never seen a white man.

R. H. Stretch.

Seattle, December 12.

The Editor:

Sir—Permit me to correct several minor errors apearing in an editorial 'Royston, or San Antone' in your issue of December 10.

Lodi is to the west of the Ellsworth range. Ione, Berlin, and Union Canyon also were important producers in the early days of mining in the Shoshone and Toyabe ranges. Ophir Canyon is about 35 miles in a straight line and nearly due north from Royston. Both are on the west side of Big Smoky valley. The Murphy mine was the main producer in Ophir canyon, with a mint record of five million dollars in silver, and probably that much more otherwise disposed of. The railroad records at Austin, the terminus of the Nevada Central railroad, show that over sixty million dollars worth of ore and bullion has been shipped by that route from this part of the State, despite the cursory system of prospecting in vogue. As an illustration I can state that I have shipped ore returning 5 to 13 oz. in gold, and silver-lead ore returning 73 oz. silver and 66% lead from several different places within 1½ miles from the old Ophir Canyon mine. All of these places yielded shipping ore at the surface. Recently 200-oz. silver-lead and 258-oz. silver ore has been found to the north and west of the old mine, not more than a mile and a half from it.

While none of these discoveries thus far have developed into a Randsburg, they are that much evidence of outcrops of shipping ore that have been overlooked. The old Ophir Canyon mine was 'worked out' several times, and is now being re-opened by the Ophir-Nevada Company.

W. F. Korf.

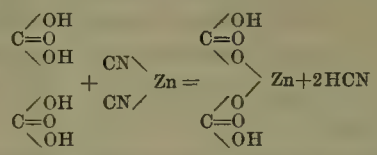
Round Mountain, Nevada, December 17.

Regeneration of Cyanide

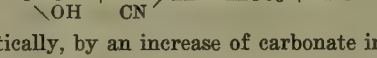
The Editor:

Sir—Referring to 'Cyanide Notes', by Algernon Del Mar, in the issue of June 11, and with reference to the statement to the effect that the regeneration of cyanide increases as the precipitation of basic zinc carbonate increases, I think that it would be difficult to precipitate the zinc salt in the presence of soluble lime salts, on account of the affinity of calcium for carbon dioxide. The precipitation of carbonate of lime would occur first, and before zinc cyanide is converted into basic carbonate.

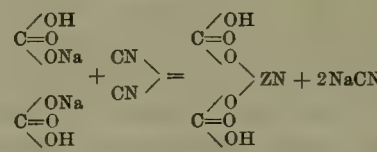
The formation of basic zinc carbonate in the solution must be due to the reaction of soluble carbonate of lime or other substance formed by the action of the air on the alkaline solution. The base of such reaction would be the carbon dioxide. The conversion of zinc cyanide into the basic carbonate would follow the equation:



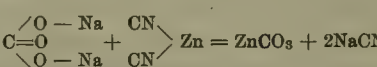
This equation indicates that for the formation of basic carbonate of zinc ($Zn(OH.CO_2)_2$) an excess of carbonate is necessary, otherwise the ordinary carbonate would be formed:



Theoretically, by an increase of carbonate in the solution, a regeneration of available cyanide would occur. If the carbonates are in excess, basic zinc carbonate is formed; if the carbonates are equal in amount to the zinc cyanide present, zinc carbonate would result. Consequently, an addition of carbonate or bi-carbonate of soda would favor this reaction; in the case of the bi-carbonate, the basic zinc carbonate would result, thus:



In the case of carbonate of soda, the ordinary carbonate would result, thus:



Although theoretically promising, this reaction is impracticable; soluble lime salts cannot effect a regeneration

of cyanide in this way. Actual tests show that by adding bi-carbonate of soda or carbonate of soda to the tailing solution, calcium carbonate precipitates first; the amount of alkali cyanide is not increased; but I found an increase of the alkalinity almost in strict proportion to the carbonate or bi-carbonate added:

$$Ca(OH)_2 + Na_2CO_3 = CaCO_3 + 2NaOH$$

I conclude that such regeneration, if it really occurs, has no connection with the formation of basic zinc carbonate; that when soluble lime salts are in excess, the precipitation of basic zinc carbonate is impossible. Consequently I can see no connection between the regeneration of cyanide and an increase of basic zinc carbonate. The addition of carbonate or bi-carbonate to a tailing solution does not affect a regeneration of cyanide.

C. FLURY.

Taiyudong, Korea, September 6.

Russian Placer Mining

The Editor:

Sir—In regard to the Perret-Purington controversy, I hold no brief for either party, but I know some of the facts and believe in fair play.

I arrived on the Lena in April 1913. Mr. Perret was then manager. Soon after, I met him and we discussed mining in general, he giving his Ural experience and I mine in the Klondike and Alaska along the same lines. He then informed me that he proposed to install winter-washing, rope-haulage, recovery of timber, with such changes in underground work as would tend to reduce costs.

About July of the same year, Messrs. Purington, Smith, and others came along. In August some arrangement was made for Mr. Smith to act as technical assistant to Mr. Perret, and follow his instructions. This he did for about one year, when Mr. Perret resigned and was succeeded by V. N. Zhurin. Mr. Perret's scheme for changes and improvements being well under way, it was continued, Mr. Smith remaining on as assistant.

Mr. Purington became consulting engineer in 1914, but no change in the working of the property according to the Perret plan was made up to the end of 1917, for I remained to the end of that year, when the Bolsheviks chased me out through Vladivostok. Mr. Purington deserves credit for pressing the Russian management to get Mr. Perret's plans carried out.

There was a mechanical elevator recommended by Mr. Purington on the Tikon mine. That was a failure, but no one seems to care to claim this. In addition to ignorance of the Russian language, Mr. Perret should have added "and character" as the cause of failure in a good many instances. Apropos of his remark as to the 17-cu. ft. dredge and its transport, the Lena company has many heavy pieces of machinery already there, such as railway locomotives. Climatically Siberia is not different from the Klondike or Alaska; in fact, there is less frost on the Bodaibo river.

The Russian engineer technically is A1. Some lack practice, but this is true of engineers in other countries. The workmen are good enough when properly directed; one must use some diplomacy to succeed in any foreign country.

W. E. THORNE.

London, November 27.

Wetting and Amalgamation

The Editor:

Sir—Probably it was only coincidence that your editorial on the waste of experience appeared in the issue in which you printed Mr. Mason's letter on wetting in amalgamation. You quote Mr. Carnegie as saying that his organization had wasted a great deal of money because it failed to find out what others had done before research and experimentation were commenced. Mr. Mason describes a series of experiments he performed about 1900, which covered much the same ground as those made by Henry* in 1855. De Sousa, Merz and Weith, Schnauss, Knaffl, Chester, and Dudley had all published their experiments along this line previous to 1890. In his determination of the solubility of gold in mercury, he had been anticipated by Kasantseff† in 1878 and by Dudley in 1889. All the literature bearing on this subject that appeared previously to 1906 was summarized in my paper on amalgamation of gold ores, published in the Transactions of the American Institute of Mining Engineers, Vol. XXXVII, p. 56 (1907). But perhaps Mr. Mason only worked for his own amusement; that would seem a justifiable inference from his not having published his results.

Reverting now to the main subject, it seems to me it cannot be discussed usefully without a more precise statement of the question than is contained in Mr. Dolbear's letter, published in your issue of November 12. When a fragment of gold is brought into contact with mercury, it is most certainly wetted by the mercury in exactly the same way that a mineral particle is wetted by oil when brought into contact with it. It is practically certain that a mercury film would be adsorbed on the gold surface in exactly the same way that an oil film is adsorbed on the mineral surface, but there the analogy ceases. As soon as the mercury comes in contact with the gold, it begins to diffuse into it, forming an intermetallic compound, whereas the oil does not diffuse into the mineral. The gold is also slightly soluble in the excess of mercury present (as shown by the references already cited), whereas the mineral is not soluble in the oil.

Comparing the use of a film of mercury on a copper plate, for the purpose of permitting gold particles in a quietly-flowing pulp of crushed ore to pass beneath the mercury surface and thus be concentrated, with the use of oil to permit air bubbles to attach themselves to ore particles in a violently agitated as well as flowing pulp, and thus float the ore particles, one may say that they are entirely different or the same according to which of the many factors that enter into each of these compli-

*'Philosophical Magazine', series 4, Vol. IX, p. 468.

†'Bulletin de la Société Chemique', series 2, Vol. XXX, p. 20.

cated processes one happens to regard as the most significant. It appears therefore that the action between gold-mercury and oil-mineral is the same or is different according to what phase of the problem one is considering; which would seem to be an ideal condition for promoting the discussion that Mr. Dolbear has invited.

THOMAS T. READ.

Washington, December 10.

Revision of the Mining Law

The Editor:

Sir—I have just read, in your issue of October 8, the letter from Robert B. Brinsmade with reference to the revision of the mining law. I found this letter especially interesting and helpful at this time as we are considering the revision of our Philippine mining laws and there is much conflict of opinion among mining men in the Philippines as to whether we should keep to the principles of the American law, that is, freehold tenure with full right to the subsoil and surface or be guided by the well-known, and by some regarded as infamous, regalian doctrine. Most of the American mining men in the Philippines naturally and sincerely believe in the principles of the old American law whereas the law-makers of the Philippines wish to re-assert the regalian doctrine. In the matter of petroleum and coal we have already changed from a freehold to a leasehold system of tenure and have separated the subsoil and surface rights both in the United States and in the Philippine Islands.

Recently a committee of Government officials acting with the advice of persons engaged in mining in the Philippines drafted a new general mining law. This is a compromise measure as the result of an attempt to harmonize a multitude of conflicting opinions. The chief bone of contention among those interested in this matter is the regalian doctrine just alluded to. This matter has received considerable publicity and notoriety in the columns of the 'Saturday Evening Post' through the facile pen of Mrs. Eleanor Franklin Egan. This excellent writer on Philippine affairs is generally well informed but when she refers to mining laws that assert the regalian doctrine as "stupid legislation" it would seem that she had got into a field of enquiry in which there is room for further study. Inasmuch as she reflects upon the law-makers of some important mining countries, and upon the judgment of some rather eminent authorities in this field, one of whom is Mr. A. C. Veatch, who was delegated by President Roosevelt to study the mining laws of Australasia and who returned a verdict in favor of the leasing system and of the separation of the subsoil and surface rights, it would seem that some objections should be raised to her exposition of the matter. Her further assertion that the regalian principle is un-American does not necessarily condemn it, but it does display a provincial bias on her part. My own stand in this matter is as follows: While agreeing to the regalian doctrine that all the people (literally the King or the State) own the minerals, I am opposed to any idea of confiscation or to making this principle retroactive with reference to lands already alienated under patent or Torrens title. The general doctrine that the mineral resources are an asset of all of the people, and that they are not for the exclusive use of a few privileged persons, is so thoroughly in accord with the modern trend of opinion as to social relationships that there seems to be no sound argument against it. Of course, the chief difficulty here arises from the fact that the Congress of the United States in the Act of July 1, 1902, did not make a specific statement on this subject, though the presumption is that that body meant to abrogate the regalian principle. Although the Philippine Supreme Court, a majority of whose members were Filipinos, rendered an opinion in favor of it, the final settlement, in my judgment, will rest with the Supreme Court of the United States. It is perfectly clear that under the Jones law the Philippine legislature was given authority by the Congress of the United States to pass such legislation as it deemed advisable having to do with all its internal affairs, and the Philippine legislature has under that authority re-asserted this principle.

I do not intend to occupy valuable space in your paper for a repetition of the many arguments that can be given on both sides of this important mooted question, further than to say that my experience in the Philippines leads me to think that the mining industry has been delayed in its development here as the result of the tying up of many good properties by speculators. Owing to the laxity in enforcement of such regulations as we have, evils of this kind have been allowed to continue that might have been avoided (and there are many ways of evading even the best of regulations). Under a well-administered leasing system legitimate enterprise can go ahead, and by canceling the lease the speculator can be curbed.

The question at issue here far transcends the mining business. It is at the root of most of our social troubles. The lines are being drawn very sharply today between the exponents of exclusive and selfish privilege on the one hand and those who believe in service and the greatest good for the greatest number on the other. It is upon this question that our civilization may sooner or later be broken. If the issue is met wisely and considerately many of our troubles will vanish; if it is not, the consequences are uncertain. In taking this view I wish to give full credit to the industrial pioneers of our great country. Many of them have been large-hearted and considerate of the public weal, but the situation in America and all over the world today is quite different from what it once was. Sooner or later the raw materials of the earth, particularly the important industrial minerals, will be looked upon as public utilities not only within the nation but among the nations. Just as there must be a different allocation of the minerals within the nation, there must be a more equitable disposition of the raw materials among the nations, otherwise it will be futile to discuss ways and means of preventing wars.

WARREN D. SMITH.

Manila, November 7.

CONCENTRATE-PITS AND CANCHAS

Ball-Milling and Flotation at Catemu, Chile—II

Flotation Practice

By F. Benitez

The ore from the Caracoles mine comes from two distinct orebodies, known as the Buenavista and Manto Monstruo. The Buenavista ore is the higher in grade and contains 5.5% copper after sorting at the mine. It is an andesite porphyry, highly altered and shattered. As the deposit is surficial, like the others in the district, most of the minerals have undergone decomposition; almost all the feldspars, the most important components, have been changed to kaolin. Other decomposition products, such as oxides of iron and chlorite, are also present. Some secondary lime, crystallized as calcite, is found in cracks and cavities. This ore is remarkable in that it contains bituminous matter impregnating the gangue. Of the copper minerals present, chalcocite predominates; but chalcopyrite, bornite, chrysocolla, malachite, azurite, and cuprite are also present. Oxidation has penetrated through fissure-planes as far down in the mine as it has been worked—80 metres from the outcrop; but the oxidized minerals occur more plentifully in the first 40 m., after which there is fairly clean sulphide ore. Most of the economic minerals, and especially the sulphides, are disseminated throughout the gangue, and occur as minute specks, almost invisible to the naked eye. Stringers of chalcocite are also found.

The Manto Monstruo orebody is a bedded bituminous shale assaying 2.5% copper; the ore is dark gray to black, much harder and more compact than that of Buenavista; it contains much calcite, occurring in veinlets; it is heavily impregnated with bitumen, and shows no signs of decomposition. The copper minerals are the same as in the first-class ore, but it contains a greater proportion of chalcopyrite, although chalcocite predominates. Galena and sphalerite are also present. An incomplete analysis of the two ores is as follows:

	Buenavista %	Manto Monstruo %
Copper	5.5	2.5
Silver	51.2	45.2
Iron	4.4	12.5
Lime	5.9	20.7
Alumina	19.7	9.8
Sulphur	2.1	2.1
Lead	0.1	0.2
Magnesia	1.8	6.2

FLOTATION. Both ores are difficult to treat by flotation, and for the following reasons:

1. The fine state of crystallization of the copper min-

erals in both ores necessitates grinding to at least minus 150-mesh, to free them from the gangue; and even then the copper loss in the tailing is chiefly in the 'chats'.

2. The ore carries, at a minimum, 1% of its copper in the form of oxide; during some months this has risen to 1.8%, or 33% of the total. Sulphidizing is, therefore, necessary to float the oxides; but, even then, most of the copper silicate is lost.

3. The decomposed state of the gangue minerals gives them flotability, which makes it difficult to obtain a high grade of concentrate. The clay particles, on agitation, flocculate and float; the use of a suitable deflocculating modifying agent is necessary, not only to break up the gangue agglomerations and to liberate the entrapped sulphides but also to stiffen the froth and to raise the grade of the concentrate.

4. Calcite, which is an important mineral constituent of the ore, floats with ease.

5. The nature of the gangue is such that it adsorbs oil freely; the carbonaceous matter liberated on grinding does likewise, and floats more readily than do the sulphides. The nature of the oils is, therefore, a question of great importance. The pine-oils, pine-tars, and generally all wood-oils have a much greater tendency than mineral oils to produce flocculation and flotation of the calcite and of the clayey constituents of these ores; if used they must be in small quantities. The wood-tars, especially in conjunction with alkali, produce a dirty, clayey, and barren froth, which is impossible to clean or disintegrate. The nature of the ores precludes the use of wood-oils; selective mineral-oils must be substituted. The consumption of oil is high; with Buenavista ore it never falls below 4½ lb. per ton. This item of cost, which in many flotation plants is but a small percentage of the total, when treating Caracoles ore (Manto Monstruo), has risen to as much as 25% of the total.

6. A large portion of the Caracoles ore that was treated came from dumps at the surface of the mine, where it had lain for three or four years. The prejudicial influences of weathering can be imagined by those who have had similar experience.

7. The ore from different parts of the mine was often as dissimilar as that from different mines. This necessitated frequent and radical changes in the quantities as well as in the composition of the oil mixtures used.

GRINDING. Theoretically this ore should be ground to minus 150-mesh (I. M. M.), for it is 'chatty' even beyond that mesh. In practice it was found impossible to carry crushing to that degree, not only because the capacity of the concentrator would have been reduced greatly but also because of the cost; moreover, the net gain was not in proportion to the reduction in the amount of copper in the tailing. The economical or commercial limit of grinding, with the Allis-Chalmers mill, lies between 80- and 100-mesh. It did not pay to go beyond that; it was found more economical to lower the grade of the concentrate to about 25%; it was then possible to float a large amount of 'chatty' middling and to keep the tailing down to a reasonable figure, 0.5% copper.

The influence of fine grinding on recovery is seen clearly in the following slide-machine test:

	Tailing, total copper, %
Ore ground to 60-mesh (I. M. M.)	3.90
" " " 80 "	1.30
" " " 150 "	0.40

Table I gives the average screen analysis of the tailing

TABLE I

	Plus 80-mesh*			Minus 80-mesh		
	Total copper %	Copper oxide %	Copper sulphide %	Total copper %	Copper oxide %	Copper sulphide %
Ferraris	1.91	0.43	1.47	1.13	0.55	0.58
Hardinge	2.04	0.58	1.46	1.06	0.53	0.53

*This and all subsequent meshes are about 10% coarser than the I. M. M. screening. The screens used were French ones, designated by the number of openings per square centimetre. Therefore 80-mesh is equivalent to 70-mesh, I. M. M.; 150-mesh, to 140-mesh, I. M. M.

TABLE II

Average screen analysis for March, April, and June 1920, of concentrate and general tailing, Buenavista ore. Mill: Allis-Chalmers. Sulphidizing practised.

	CONCENTRATE				TAILING			
	% weight		Copper	Insoluble	% weight		Total copper	Copper oxide	Copper sulphur
Mesh	Cumulative	Individual	%	%	Cumulative	Individual	%	%	%
Plus 80	4.5	4.5	10.5	51.2	4.5	4.5	1.35	0.47	0.88
" 100	15.0	10.5	10.4	62.3	15.0	10.5	1.08	0.25	0.83
" 150	19.7	4.7	14.2	56.6	19.7	4.7	0.83	0.25	0.57
" 200	30.7	11.0	20.8	46.8	30.7	11.0	0.81	0.24	0.57
Minus 200	...	69.3	27.8	35.7	...	69.3	0.73	0.54	0.19

from Buenavista ore, for three months with the Ferraris and for four months with the Hardinge mill, during 1918 and 1919. Table II shows clearly that fine grinding is necessary, not only to obtain a low tailing but also to produce a high-grade concentrate. The percentage of

TABLE III

Average screen analysis for the month of November 1920 of flotation concentrate and general tailing, Buenavista ore. Sulphidizing with sodium polysulphide practised

	CONCENTRATE					TAILING				
	% weight		Total copper	Copper oxide	Insoluble	% weight		Total copper	Copper oxide	Copper sulphur
Mesh	Cumulative	Individual	%	%	%	Cumulative	Individual	%	%	%
Plus 80	0	0	...	...	...	1.1	1.1	1.17	1.19	0.98
" 100	6	6	10.1	0.56	60.4	7.2	6.1	0.98	0.13	0.85
" 150	11	5	12.5	0.98	55.6	12.3	5.1	0.73	0.21	0.52
" 200	19	8	16.7	1.37	48.8	24.7	12.4	0.73	0.21	0.52
Minus 200	..	81	27.5	3.47	33.4	...	75.3	0.38	0.50	0.08
Total		100					100.0			
Assay direct			24.3					0.63		
Oxide			1.59(?)					0.25(?)		

copper as copper oxide in the minus 200-mesh proportion of the tailing is 74%; in the plus 80-mesh product it is only 34.8%, showing clearly a concentration of the oxide in the minus 200-mesh. Almost the whole of the copper oxide lost in the minus 200-mesh was the silicate, or chrysocolla, which would not float even if sulphidized to a black color. The sulphides lost in the minus 200-mesh product were mainly tarnished sulphides and some fine 'chats'.

An incomplete analysis of the concentrate for November 1920 was as follows: copper, 24.3; copper oxide, 1.59; insoluble, 49.6; silica, 33.2; iron, 9.6; magnesia, 1.74; lime, 4.2; alumina, 16.5; sulphur, 9.1; lead, 0.7; zinc, 0.43. The assay of the minus 200-mesh products in concentrate and tailing shows that the oxidized minerals slime easily. The best oxide recovery was obtained from the minus 200-mesh material.

Flotation of the Oxidized Minerals. Buenavista ore carries, on the average, 1.2% of oxidized copper out of a total of 5.5%, or 22% of the total. The recovery of such was of importance because, no matter how good was the recovery of sulphide, we could not expect a good total recovery without effecting a satisfactory saving of oxidized minerals. These were chiefly malachite, azurite, chrysocolla, and cuprite. It was noted that such oxidized minerals, especially the two carbonates, had a tendency to float, even without the aid of any sulphidizing agent. The recovery of the oxides was always above 50%. Undoubtedly, some of the oxides were recovered by the Wilfley table upon which the de-slimed sand tailing from the flotation machine was passed, but the main recovery was made by flotation.

The first attempt at sulphidizing the oxides was made at the La Poza mill, and consisted in feeding sulphuretted hydrogen gas into the agitating-boxes of the M. S. machine. The gas was made by heating Mexican crude petroleum with sulphur at 300°C.; although at times it was produced, often there was a preponderance of something else. After minor explosions and a few cases of poisoning, the experiment was discontinued; not only was the production of the gas difficult, but its delivery to the flotation machine introduced complications. The poisonous nature of the gas was a danger to the Chilean operators who, strange as it may seem, were always keen to smell it. The use of soluble sulphides or polysulphides was inevitable; sodium sulphide was first tried. Although the presence of this compound was found to be beneficial to the flotation of the oxidized minerals, its sulphidizing action was not marked, due probably to its low sulphur content. Consequently, the fused sodium polysulphide of commerce was tried and with more satisfactory results. This reagent had been recommended to us by K. Pettigrew, of the M. S. company, who had tested the ore in London with a view to possible improvements in flotation treatment. At first the polysulphide was added at the mill in lump form and at the rate of 4 lb. per ton of ore, the idea being to grind the ore and the polysulphide together, and where the pulp was thickest.

Assuming that the success of the flotation of oxidized minerals depends on the presence of a coating of artificial sulphide, it was thought that the mill would be the ideal place to add the reagent, because the solution there would be more concentrated than in the flotation machine, where the ratio of water to solids was 4.5 to 1. However, whether that was so or not was never ascertained, because sodium polysulphide, being a strong deflocculator, upset the separation at the classifier and caused more harm than good; it caused this machine to discharge a much finer material. This contradictory behavior of the strongly deflocculated pulp appeared difficult to explain, in view of the fact that flocculation is necessary for settlement or clarification. The polysulphide increased the rate of settlement in the classifier and acted as lime; with 4 lb. added at the mill only minus 200-mesh material would overflow, although the water-to-solid ratio in the classifier was 4.5 to 1, and therefore the classifier should have been discharging at minus 100-mesh. Yet there was no question of the deflocculated state of the pulp. The only explanation was that the polysulphide had no influence on the coarse particles (plus 200-mesh); and that, having broken the kaolin floccules, it allowed the coarse particles to settle more rapidly; or that it affected both sizes differently, causing the coarse to flocculate and settle and the fine to deflocculate and discharge.

The polysulphide was next tried at the first agitating-box of the flotation machine and added there in the form of a supersaturated solution. After many trials it was found desirable to add it from an ordinary paraffin-can, to which a spout was soldered at the bottom. The can was filled to the top with lumps of polysulphide, and a stream of water was added from a hose. In this way the can was always filled with a saturated solution, and the amount of reagent used could be regulated closely by means of the stream of water; the reagent is added at the same rate as it dissovles; if dissolved long before use it was found to have lost its strength.

When the polysulphide was added at the first agitating-box it interfered slightly with the flotation of the sulphides; consequently, it was gradually moved down toward the tail-end of the machine until, after much experimenting, it was found that the best recovery was obtained by adding it at the sixth agitating-box. By this arrangement the first six boxes floated the sulphides; the next three, the oxides; and the last four overflowed as usual and the pulp was returned to the head machine. As already mentioned, sodium polysulphide is a deflocculating agent, also a strong caustic alkali. Its action as a sulphidizing and a deflocculating agent can be discussed together; it was used with the Caracoles ore because of its dual properties. The amount found necessary to deflocculate the pulp and to float the oxides varied from 1½ to 2½ lb. per ton of ore, the average being about 2.2 lb. The quantity added was varied, the amount depending on the nature of the ore; it was regulated by the deflocculating action on the froth, irrespective of the oxide content of the feed; it was found in practice that, gen-

erally, the higher the amount of oxide in the feed the greater was the amount of polysulphide required, the reason being that the oxidized ore came almost exclusively from the outcrop. The decomposed gangue minerals, and especially the clay from this outcrop or weathered ore, agglomerated strongly, and caused a voluminous, watery, and barren froth. This froth was of a dirty reddish-yellow color, caused by the inclusion of much colloidal clay. The same type of froth was produced when the ore contained a large proportion of fine. Wood-tar oils had a tendency to lift such clay floccules, and for this reason their use had to be restricted to small quantities. Moreover, when a wood-tar oil was used as a frother, the pulp was found to be more difficult to deflocculate; the froth that resulted, if an excess of polysulphide was used in an effort to clean it, was like a scum. If, on account of fine material or weathered ore, the froth became voluminous, barren, and of a reddish color, the amount of polysulphide was gradually increased. Slowly the froth would lose its red color and would flow well toward the paddles, losing its tendency to 'hang back' and 'lift' at the back of the boxes. The bubbles could then be seen to be well armored with sulphides, the larger ones being bridged by smaller ones; the resulting froth would be dry, and would break up immediately on falling to the concentrate launder.

When froth was in the condition just described, the pulp was found to be completely deflocculated. The froth from the sixth to the eighth boxes would often be of a distinct grass-green color; and once, when sent to the assay office, returned 13% of oxidized copper in a 17% concentrate. The froth where the polysulphide was added was always shallow, about 2 to 3 in. deep, and often on the point of breaking; on being re-agitated on the succeeding box, however, a good strong froth resulted, which gained in body and volume as it received more agitation. However, if enough polysulphide was added, it was possible to 'kill' the froth entirely, and then re-agitation on the succeeding boxes would not result in a froth. The machine would then take the appearance due to the over-oil effect.

Action of Polysulphide. Two possible explanations of the action of polysulphide in killing the froth can be advanced. The first and more simple would be that the deflocculation of the pulp had been carried too far, and that the sulphide had been put into the condition of a true suspension. The second would depend on the formation of a soluble soap by the action of the sodium hydroxide contained in the polysulphide upon the oils. Sulman[1] said: "Because of its pronounced adsorption at a water-solid interface, soap is selectively adsorbed at, and consequently detaches oil and grease from, surfaces already oiled. Selective adsorption thus accounts for the detergent properties of soap".

In this connection it will be interesting to mention that caustic soda had been previously tried as a deflocculator, and that its effect was the opposite to that sought and expected; it increased the volume of the froth and lowered the grade of the concentrate. On one occasion, having no vegetal tar, a local oil produced by the destructive distillation of wood in the making of charcoal, I was compelled to use Mexican crude petroleum and pine-oil. Such a mixture, being composed of two selective oils, one a collector and one a frother, produced too delicate and tender a froth; it was difficult to work, for it lacked the third oil, vegetal tar, which, being a strong frother, gave to the froth the necessary body, volume, and stability. Remembering the effect of caustic soda on a previous froth, of greatly increasing its volume, a concentrated solution of caustic soda was added at the first agitating-box; the froth steadied, and became workable; the results, which previously had been erratic, again became normal. The effect of the caustic soda almost reproduced that of the missing oil. As a general rule i was found that, on all Catému ores, it was not possible to use alkali with a wood-tar; a 'spume' was produced.

Use of Caustic Soda. Caustic soda was tried on Caracoles ore in an endeavor to deflocculate the pulp; sulphuric acid was useless on account of the calcitic and decomposed nature of the gangue. Although amounts varying from ½ to 10 lb. per ton were tried, no beneficial effect resulted. In his article on colloids, E. E. Free discussed the effect of caustic potash on the degree of flocculation of kaolin suspensions. In the curve showing the degree of flocculation for different concentrations of caustic potash the maximum degree of flocculation is reached with a concentration of from 0.1 to 0.8 gramme per litre. In a pulp with a ratio of water to ore of 4.5 to 1, the quantities required to effect such maximum deflocculation would be from 1 to 8 lb. per ton of ore. These amounts correspond with those recommended by Sulman (1 to 6 lb.). Although in practice the amount used was slowly and carefully increased from ½ to 10 lb., no marked deflocculating effect was noticed, yet the conditions were as similar to those in Free's experiment. In one case it was desired to deflocculate a kaolin suspension with caustic soda, the physical and chemical properties of which are identical with those of caustic potash. Perhaps the negative result was due to the use, at the time, of vegetal tar, which, as we afterward ascertained, was inimical to the alkali.

As fused sodium polysulphide is expensive, costing at Catému ₱1.05 per pound or ₱2.30 per ton of ore treated, an endeavor was made to manufacture it locally, by treating a boiling concentrated solution of caustic soda with sulphur.[2] Several classes of polysulphide were made; although they sulphidized and floated the oxides, their deflocculating action was weak as compared with that of the imported fused article. This polysulphide, which is made by heating sodium sulphate and carbon to 600°C., is strongly caustic and not fully saturated with sulphur; a solution of it will absorb considerably more

[1]H. L. Sulman: 'A Contribution to the Study of Flotation'.

[2]This polysulphide could be made at Catému for half the cost of the imported article or 50 centavos per pound.

sulphur on boiling. Yet the strongly caustic polysulphide gave splendid results as a deflocculator. In every instance the results obtained with the fused polysulphide were far superior to those that resulted by using the home-made article. This may have been due (as Gahl indicates) to the formation of thiosulphates and other oxygen-sulphur compounds.

Use of Sodium Silicate. This modifying agent was also found to deflocculate the Caracoles ore-pulp strongly, 1 to 2 lb. per ton of ore being sufficient; but, as sodium polysulphide had to be used in any case to float the oxidized copper minerals, it was only added in those rare instances in which polysulphide alone was not sufficient to effect the deflocculation of the pulp. It has, however, one advantage over this reagent: it can be used with wood-tars without causing 'spuming'. It is also cheaper, costing only 27 centavos per pound.

Flotation of Manto Monstruo Ore. All that has been said of Buenavista ore applies equally well to the flotation of Manto Monstruo ore, except that it is even more difficult to treat. Owing to the presence of high percentages of calcite and bitumen, it adsorbs oil strongly, and from 5 to 7 lb. per ton is required to effect flotation; 4 lb., an amount that would be considered excessive with many ores, would often not give a froth. From 40 to 60% of the copper in this ore was oxidized (1.0 to 1.5% in a 2.5% head), it was almost impossible to obtain a low-grade tailing, no matter how finely ground. At least 3 lb. of polysulphide was required to float the oxides; but for the deflocculation of the pulp, much larger amounts than this were required.

Sodium silicate was found useful as an additional modifying agent. All the gangue in this ore had a marked tendency to float; in order to obtain a 0.4 to 0.6% tailing, only an 8% concentrate could be secured. During the time that this ore was being tested it was noticed that the mill had developed a muffled noise, and that its capacity was reduced to nil. On opening, it was found that most of the lining and the surface of the balls had become coated with a compound much like plumbago; this was made, it was presumed, by the absorption of the Mexican crude petroleum by the bituminous matter in the ore. This viscous oil, when used with this ore, had a tendency to form this compound, which adhered strongly to iron; for this reason part of the petroleum was replaced by coal-tar. Because of its toughness, low copper content, and unsuitability for flotation, the treatment of this ore was discontinued. The results of a trial run on 650 tons are given in Table IV.

An incomplete analysis of the concentrate is as follows: copper, 13.9; insoluble, 44.8; silica, 37.4; iron, 5.8; magnesia, 1.40; lime, 9.6, alumina, 9.9; sulphur, 7.5; lead, 2.9; and zinc, 4.3.

The oils used on this test (average figures for the whole of the trial-run) were:

M. S. fuel-oil	4.00	lb per ton
Mexican crude petroleum	1.40	" " "
Coal-tar	0.80	" " "
Pine-oil	0.50	" " "
Total	6.70	lb. per ton

Oils Used with Caracoles Ore. Almost all the oils on the market, in England and in the United States, were tried on this and the other Catému ores, both by the company's staff and by outside metallurgists. A successful mixture, which served the purpose well during the early days when trouble and under-capacity in the milling section caused too coarse a feed to go to the flotation machine, consisted of Mexican crude petroleum, vegetal tar, a by-product obtained in the making of wood charcoal, and steam-distilled pine-oil. Mexican crude petroleum was by far the best collector; on account of cheapness—its cost at the plant was only 1 cent (U. S. currency) per pound—it could be used in large quantities (2 to 3 lb. per ton) to saturate the carbonaceous oiled matter in the ore. I do not mean to imply by this that the bitumen in these ores would not adsorb a more selective oil, such as pine-oil, in the presence of Mexican crude petroleum, but that the more selective oil, being also more soluble, went into solution to a greater degree than did the collector. This latter, on account of greater viscosity and non-solubility, was, in turn, adsorbed by the bitumen to a greater degree than was the selective oil. That this surmise was correct was proved later by the fact that when Mexican crude petroleum was used with the bituminous shale, the bitumen and oil were found to mix and coat the balls and lining in the ball-mill.

Mexican Crude Petroleum. Mexican crude petroleum could be used in large quantities because of its non-frothing and collecting qualities. A collector with greater frothing qualities, such as coal-tar, could not be used in larger amounts than 1 to 1½ lb. per ton, otherwise the grade of the concentrate would be lowered considerably. Coal-tar was also found to lift the colloidal clay; it was also three times as expensive as Mexican crude petroleum. Vegetal tar was used as a frother for about 18 months at the Chagres mill, together with the Mexican crude petroleum. It produced a voluminous and tough froth that, though non-selective, served admirably to lift the 'chats' that were left in the feed because of insufficient grinding. The froth made by this oil never broke; a depth of from 12 to 18 in. could be

TABLE IV

Average screen analysis of flotation concentrate and general tailing of trial run on Manto Monstruo ore. Sodium polysulphide used.

		CONCENTRATE			TAILING				
		% weight		Total copper	Insoluble	% weight		Total copper	Copper oxide	Copper sulphide
Mesh		Cumulative	Individual	%	%	Cumulative	Individual	%	%	%
Plus	100	..	4	7.45	58.4	..	4	0.80	0.14	0.66
"	150	10	6	6.40	56.4	10	6	0.85	0.16	0.69
"	200	20	10	8.80	43.6	20	10	0.85	0.22	0.63
Minus	200	..	80	15.00	56.0	..	80	0.90	0.58	0.32
Assay				13.90				0.95	0.40	

carried in the spitzkastens of the flotation machine. In the early days, and before the design of the M. S. machine was improved, a deep froth was a necessity in Catému, because the untrained Chilean operators could not handle a shallow froth (2 to 4 in.), using all the valves in the machine, without overflowing. This oil had a tendency to float much clay; when a little in excess of the right amount was used, the plant was flooded with froth; this was particularly noticeable when the feed contained too much fine material, the so-called primary slime. Steam-distilled pine-oil was used (½ to ¾ lb. per ton) as an auxiliary oil on this ore; it was found that vegetal tar, if used alone, produced a high froth that would adhere to the back of the boxes and that would not flow toward the paddles. Such a froth would 'shower'. Pine-oil was used to correct this. Pine-oil was found also to produce good flocculation of the fine sulphides, and was the best oil for floating the oxidized minerals.

VEGETAL TAR. Vegetal tar was unsuitable because the shipments varied considerably in composition; the oil had a tendency to hydrolize, yielding a soluble portion and a viscous portion, the latter being difficult to feed. This oil was expensive, 79 centavos per pound; the discard of large quantities, because of decomposition, was a serious matter; it was replaced by M. S. fuel-oil. This oil, as far as I could ascertain, is a blast-furnace product, to which some cresol or cresylic acid has been added; it is thin and of a reddish-brown color; it has a specific gravity of 0.940 and is a powerful frother and collector. When used alone it would give as good results as in combination with other oils, but it was found economical o use is as part of a mixture made up with an equal portion of Mexican crude petroleum. If used alone, 4 to 5 lb. of M. S. fuel-oil had to be used with Buenavista ore to obtain a 25% concentrate from a 5.5% head with a 0.4% tailing, and after grinding to minus 100-mesh (I. M. M.). As M. S. fuel-oil cost, at Catému, 42 centavos per pound, the cost for oil alone would be ₱1.90 per ton. By using a half to half mixture of M. S. fuel-oil and Mexican crude petroleum the cost was only 85 centavos per ton of ore—a reduction of nearly 45%.

M. S. fuel-oil was almost an ideal oil for Catému ores. It possessed the essential properties. Being both a frother and a collector, it could be used alone, and this makes for simplicity. It was fairly selective in action, and yet gave a froth that was voluminous, steady, and easy to work, producing both a good grade of concentrate and a clean tailing. Its composition never changed. It was made, I suppose, according to a fixed formula, and did not decompose by either heat or cold. Being a thin oil, it could be fed from any type of feeder; because of its solubility it could be added either at the flotation machine or at the mill. The disadvantage in its use was seen in high price and the tendency (when used in amount above 2 lb. per ton) to make a high 'windy' froth. Pine-oil and polysulphide would correct this. Unlike the pine-tars, M. S. fuel-oil does not lift colloidal clay; it works as well with acid as with alkali. After long experimenting it was found that either one of the following mixtures could be used with Buenavista ore and with equally good results:

Collector	Mexican crude petroleum, 2 to 3 lb. per ton, or Coal-tar, 1 to 1½ lb. per ton
Frother	Minerals Separation fuel-oil, 2 to 2½ lb. per ton
Auxiliary oils	Pine-oil, 0.3 to 0.5 lb. per ton, or Refinery acid, 0.5 to 1.0 lb. per ton, or Pine-tar, 0.1 to 0.2 lb. per ton

Table V gives the results of competitive tests under similar conditions, to ascertain the relative advantages of pine-oil and refinery-acid oil in a mixture of about one-half Mexican crude petroleum and one-half M. S. fuel-oil; 2.2 lb. per ton of polysulphide was used in each case. The advantage was with the mixture containing the pine-oil. Refinery acid-oil could be substituted for pine-oil; it produced good flocculation of the minus 200-mesh chalcocite.

TABLE V

	Feed, total copper %	Copper oxide %	Copper sulphide %	Copper concentrate %	Total tailing %	Sulphide tailing %	Oxide tailing %	Recovery, total %	Recovery, sulphide %	Recovery, oxide %
Test No. 1	5.43	1.28	4.15	23.00	0.48	0.14	0.34	93.2	98.3	80.3
Test No. 2	5.07	1.24	3.83	22.90	0.44	0.11	0.33	92.8	97.6	79.0

Oils Used in Test No. 1

		Cost
M. S. fuel-oil	2.7 lb. per ton	₱1.13
Mexican crude petroleum	3.1 " " "	0.23
Pine-oil	0.4 " " "	0.28
Total	6.2 lb. per ton	₱1.64

Oils Used in Test No. 2

		Cost
M. S. fuel-oil	2.3 lb. per ton	₱0.97
Mexican crude petroleum	1.8 " " "	0.14
Refinery acid-oil	1.2 " " "	0.96
Total	5.3 lb. per ton	₱2.07

CHARACTER OF OIL USED. Although many have argued that the amount and the kind of oil used are of little importance, and "that one oil is about as efficient in flotation an another"[3], my experience with the Catému ores leads me to dissent. The quantity and kind of oil used with any ore are of paramount importance in the successful flotation of that ore. Mr. Ruth, however, qualifies his statement by saying that other factors, especially the violence of the agitation, must be adjusted to suit the character of the oil used. But surely it is more economical to secure an oil to suit a particular ore and set of operating factors than to change those factors to suit an oil. I believe that this is what actually happens in practice: the oils are changed to suit the ores and the operating conditions, and not the conditions changed to suit an oil. To change an oil is a simple matter; to change the conditions in a plant that is in operation is far more difficult and costly. My experience with the Catému ores leads me to believe that the difficulties depend more

[3]Joseph P. Ruth, Jr. 'Eng. & Min. Jour.', Vol. 107.

upon the physical nature of the gangue than on the degree of floatability of the mineral. The troubles with us arose mainly from the decomposed nature of the gangue minerals, as well as from insufficient grinding. All the Catému orebodies are superficial; and this, coupled with their shattered, broken, and brecciated nature, has enabled oxidation and decomposition to alter greatly their original character. Apart from the finely disseminated or 'chatty' occurrence of the copper minerals, which necessitated fine grinding, the difficulties came mainly from the physical character of the ores; the Caracoles ore adsorbed oil freely, and a thick pulp was produced through which the bubbles with their load of sulphides experienced difficulty in rising. In the Cardenilla ore the trouble was caused by limonite; in the dump-ore from Los Mantos mine, an efflorescence of salts of magnesium and calcium sulphates gave rise to a curdish precipitate, almost cheese-like in its consistence. K. Pettigrew investigated this, and found the cause of the trouble in the Cardenilla and Los Mantos ores. The use of alkaline deflocculators has already been explained.

The important rôle played by the oils in the flotation of the Catému ores cannot be over-emphasized. Theoretically, oil is not an essential factor in flotation, but air, and any substance like amyl alcohol that will slightly reduce the surface-tension of the water and will allow the formation of a large and strong froth, will do the work; nevertheless, the fact remains that oil is still an essential in flotation plants. A suitable oil and a deflocculated pulp are the two essentials for the successful flotation of the Catému ores, with thorough and violent agitation as an adjunct.

Flotation Machines. Much has been written about the relative advantages of the flotation machines on the market. Within certain limits (and leaving out such factors as upkeep, capacity, and simplicity of operation), I think that one machine is as good as another, if the pulp is in the proper condition. I believe flotation operators would do well to adopt the advice given by E. D. Peters in one of his books on copper smelting: "Look after the slag and the matte will look after itself", modifying this to suit flotation, thus: "Look after the gangue and the sulphides will look after themselves".

Salado. This orebody, which is one of the Catému group, consists of a series of rhyolitic-lava beds, lying on top of one another and dipping at an angle of 30°. All the beds are mineralized and have well-defined hanging walls, the mineralization occurring chiefly next to the hanging wall and gradually diminishing toward the bed next below. The copper minerals include high-grade bornite and chalcopyrite; these are sometimes found together. Azurite, malachite, and chrysocolla are confined mainly to a single bed, the ore from which is smelted direct. The important economic minerals, bornite and chalcopyrite, occur chiefly as fillings in the vesicles of the lava, but also replace the feldspars. The gangue minerals are quartz and feldspars, fresh and unaltered.

A typical analysis of the ore is as follows: copper, 5.1% (after hand-picking); copper oxide, 0.1 to 0.2%; silica, 62.2%; iron, 3.1%; lime, 2.6%; alumina, 20.0%; sulphur, 2.3%. The sulphide ore from this mine is easy and cheap to treat by flotation. The copper minerals break free from the gangue at 40-mesh, and no reagent in addition to the oil is required. A 30% concentrate with a 0.2% tailing can be secured with almost any oil mixture that was tried; only five boxes out of the twelve were run to concentrates, the pulp from the other seven being returned to the head of the machine. Almost the whole of the mineral floated in the first two boxes; the froth produced was always well armored, and had the characteristic dry appearance given only by minerals with a high contact-angle. The gangue, being clean and fresh, was wetted and sank easily and without the help of any modifying agent. However, when an excess of surface-ore was mixed with the current run of sulphide ore, the decomposed gangue minerals acted as 'poison', and fine kaolin flocculated and floated, making the froth voluminous and dirty. From ½ to ¾ lb. of sodium silicate added at the head of the machine was sufficient to correct this trouble; this was found to be the best modifying agent for the ore, for strongly alkaline reagents always caused high tailing. For this reason, if the feed contained sufficient oxide to justify the use of sodium polysulphide, this reagent had to be saturated by boiling with sulphur until neutral; if added unsaturated toward the tail-end of the machine, the pulp made alkaline could not be returned to the head of the machine for re-treatment.

Table VI gives the average screen analysis of flotation concentrate and general tailing for a month's run (1250 tons) on Salado ore. An incomplete analysis of the concentrate was as follows: copper, 38.4%; copper oxide, traces; insoluble, 21.8%; silica, 13.4%; iron, 13.9%; magnesia, trace; lime, 0.5%; alumina, 12.0%; sulphur, 20.4%; lead, 0.1%; zinc, 0.2%.

As will be seen from the screen analysis, the sulphide, being much heavier, slimed to a greater degree than did the gangue, the proportion of minus 200-mesh being 70 and 47% in concentrate and tailing, respectively. The

TABLE VI

	CONCENTRATE				TAILING			
	% weight		Total copper	Insoluble	% weight		Total copper	Copper oxide	Copper sulphide
Mesh	Cumulative	Individual	%	%	Cumulative	Individual	%	%	%
Plus 50	..	2	29.4	29.4	..	3	0.35	0.08	0.27
" 80	5	3	29.4	32.4	17	14	0.15	0.06	0.09
" 100	13	8	35.6	22.4	32	15	0.20	0.06	0.14
150	19	6	39.9	16.2	40	8	0.25	0.04	0.21
" 200	30	11	44.9	10.2	53	13	0.25	0.08	0.17
Minus 200	..	70	40.0	21.0	..	47	0.33	0.18	0.15
Total		100				100			
Assay direct			38.4	21.8			0.27	0.10	0.17

concentrate that was richest in copper was in the two finest meshes, showing that the ore was slightly 'chatty' though not so 'chatty' as were the other Catému ores. This fact was confirmed independently by examination of the tailing under the microscope, which showed that some of the copper sulphide was lost in the 'chats', although the greatest proportion consisted of tarnished sulphides. The most important oxidized copper mineral in this ore was chrysocolla, which occurs mainly as a thin film along small fissure planes or channels. The Wilfley table, despite the lowness in grade of the feed, never higher than 0.4% copper, made a 5% concentrate on the average. The remainder of the mineral saved by the table consisted mainly of specular iron; this, being almost of the same specific gravity as the bornite and the chalcopyrite, had to be taken off with the latter. The Salado tailing, being more suitable for tabling than Caracoles tailing, always gave a higher ratio of concentration. The table-concentrate, although of low grade, was self-fluxing and could be smelted. An incomplete analysis of the table concentrate obtained from the flotation-machine sand was as follows: copper, 4.9%; insoluble, 2.4%; iron, 59.6%; sulphur, 0.6%.

Oil Mixtures Used on Salado Ore. Almost any mixture consisting of a good collector and a good frother gave satisfactory results but, for obvious reasons, those oils that gave the best recovery at the lowest cost were chosen. Yet in a small plant, such as the Catému, where as many as five different ores might be treated during one month, we had to aim, as far as practicable, to secure a mixture that consisted of no more than three different oils, otherwise confusion in the ordering of the oils would have resulted. Such a mixture consisted of M. S. fuel-oil, steam-distilled pine-oil, and Mexican crude petroleum. During the month of September 1920 the following quantities were used in treating Salado ore:

M. S. fuel-oil	2.00 lb. per ton
Steam-distilled pine-oil	0.26 " " "
Mexican crude petroleum	2.03 " " "

A simpler mixture used on Salado ore consisted of Mexican crude petroleum (2 lb. per ton) as a collector, and local vegetal tar as a frother. This gave good results; but, owing to the extremely variable composition of the vegetal tar, its use was discontinued. On Salado ore, coal-tar could be substituted for Mexican crude petroleum, and only 1 to 1½ lb. per ton was required instead of 3 lb. as with the Mexican crude petroleum. However, as coal-tar costs three times as much as Mexican crude petroleum no advantage was gained by the change.

Minerals Separation Machine. The M. S. machine was the standard 12-box machine. The agitating-boxes were 18 by 18 in., with 12-in. brass agitators of the cruciform pattern. The agitating-boxes were lined with 2-in. local-oak planks, and the wooden lining would last for the treatment of 16,000 tons after reversing the planks once. The brass agitators lasted for the treatment of 8000 tons. The machine was driven by the usual quarter-turn belt-drive from a 40-hp. Allis-Chalmers induction-motor. The power taken by the motor to drive the machine was 30 hp., or 2½ hp. per agitator, when the agitators were running at 450 r.p.m. The maximum capacity of the machine was 75 tons per day on slime; it was built at a height of 12 ft. from the ground, and rested upon a concrete arch. So firm were the foundations that no vibration could be noticed, even when standing on the machine itself.

The mechanical design of the machine was found to be satisfactory, but the multiple-valve device for regulating the rate of flow of the pulp through the machine gave trouble at first. A valve in each spitzkasten controls the amount of pulp going to the next agitating compartment. The Chilean operators lacked the necessary patience to adjust the level of the pulp in any one box slowly enough, and would not wait for the effect caused by altering a valve on the succeeding box. They wanted to adjust all the boxes at the same time; the inevitable result was that one box would be empty of pulp and the next one would be overflowing. E. D. Pope invented an ingenious device by means of which the pulp in the whole of the machine could be controlled by only 2 valves instead of by the 12 previously required. A slot 26 in. long by 4 in. high was cut in the second, third, fourth, fifth, sixth, and seventh partitions that separate the first eight flotation boxes from one another. The slots in the concentrate boxes were made so that the upper cut was 4 in. below a horizontal line drawn from the overflow point of the box, as in Fig. 1. The first eight boxes when so arranged

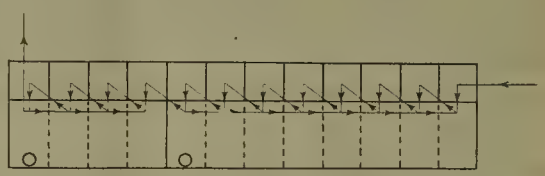


Fig. 1

acted as one single box, and a valve at the eighth box regulated the outflow of pulp to the next four, or middling, boxes. The partition between the eighth and ninth boxes was not slotted. The ninth, tenth, and eleventh partitions were slotted; but the upper cut in these slots

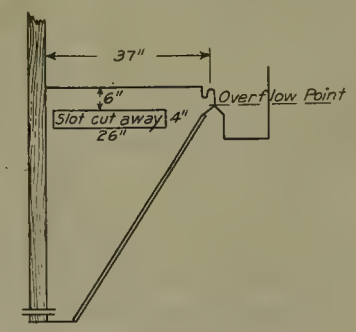


Fig. 2

was made, 1 in. below the overflow point, into the concentrate launder, instead of 4 in., as in the concentrate-boxes. A valve at the twelfth spitzkasten regulated the final exit of the pulp from the machine. Thus the first eight spitzkastens making concentrate acted as one box,

and the last four, or overflowing, spitzkastens as another.

The *modus operandi* of the machine on starting was as follows: Suppose that the machine was receiving 1 in. of pulp. As the connecting pipes are 2 in. diameter, all the pulp flowing into the first spitzkasten would be elevated immediately by the second agitator, there being no valve to check it, and discharged into the second spitzkasten; all the pulp arriving at the machine would rapidly pass into the eighth spitzkasten where the valve would check its further flow. The eighth box would fill rapidly, having no outlet, until the pulp reached the level of the slot joining the eighth and seventh spitzkastens, when it would flow into the latter (the seventh), and so successively back again from the eighth to the first box. As soon as froth began to overflow from the machine, the valve at the eighth box would be opened to allow 1 in. of pulp to exit into the other section of the machine (ninth to twelfth boxes); as soon as pulp began to overflow from these the valve at the twelfth box would be opened to allow 1 in. of pulp to discharge from the machine.

The device was criticized; it was argued that it allowed the machine to by-pass; in other words, the pulp could go through the machine without receiving sufficient agitation and treatment. But experience showed that such was not the case. Although the machine has a rated capacity of 75 tons per day, as little as 15 tons, or one-fifth was treated in a day, showing that the pulp could be retained as long as desired. In a machine that is working at full capacity, the slotting of the flotation boxes will show no great advantage, all the valves being almost open; but in machines not working at full capacities the arrangement will be worth while, especially where unskilled labor is employed. Any intelligent operator can learn to work a slotted machine in a shift; much less pulp has overflowed into the concentrate launder since the adoption of such machines at Catému, and one operator suffices, whereas two were required previously.

I wish to say a word of praise for the Dorr classifiers. These machines worked under hard conditions, but they operated well. Not a single shut-down was recorded against them during five years; the only part to be renewed was the roller on which the eccentric works. Credit is due to the Dorr engineers for having developed a machine that has reached such high efficiency. The Frenier sand pumps elevating the pulp to the flotation machine have also done excellent work. These pumps have elevated 50 to 70 tons of sand and 225 to 315 tons of water 22 ft. per 24 hours. The only parts that require renewal are the packing-pieces and the hollow shafts.

Settling of Concentrates. Neither thickener nor filter was used at the Chagres mill. The concentrate was laundered directly to three pits, 3 ft. deep and 340 sq. ft. in area, the fall and a certain amount of raking being sufficient to break up the froth. No trouble was encountered in disposing of flotation concentrate in this manner. The overflow passed through another five pits of the same size, where any remaining slime settled. The water overflow from the last pit was clear, and was pumped to the main supply-tank. The settled concentrate was shoveled into one-ton cars, and spread to dry on a plat with a concrete floor. The moisture in the concentrate when at the smelter was 10% in summer and 20 to 25% in winter.

Tailing Disposal. The tailing was elevated 30 ft. by an 8-in. bucket-elevator, with buckets spaced at 12-in. centres. The belt was of 8-in. balata, traveling at 350 ft. per minute. The tailing was distributed around the dam by means of V-shaped launders with 1-in. round holes drilled at the apex. One man working eight hours per day kept the walls at a height of 3 ft. above the surface of the water. The overflow was clear and was taken out by means of a 3-in. pipe with a right-angle elbow. The water was not re-used because, contrary to expectations, the practice did not decrease the consumption of frothing-oils. My belief is that detrimental salts in the tailing water more than counterbalanced the beneficial effect of those portions of the oils that had gone into solution.

Labor. The total number of men employed at the Chagres mill is 25, distributed as follows: one foreman, one mechanic, one laborer on the tailing-dam, one man grinding and drying the samples, and three men digging the concentrate in the pits, and spreading it out to dry on the *canchas*. These men work on the day-shift only. On each of the 8-hour shifts there were: one man on the M. S. machine, who also looked after the flotation oils, and acted as shift-boss; one boy on the crusher and ore-elevator; one millman and oiler; one boy for the concentrate pits, for raking the froth, and for looking after the centrifugal pumps; and two men hauling the ore to the mill-bin from the ore-plat. The payroll for the month was ₱4500, so that the average wage for an 8-hour shift was ₱6, or about 60 cents, American currency, at the present rate of exchange, which is very nearly ₱10 per U. S. dollar.

After three years of continuous dealings with Chileans, under trying and adverse conditions, I say with conviction that I would be content to handle no better labor for the rest of my life. The Catému company camps are 'open'; although the introduction of liquor inside the company's premises is prohibited, such prohibition is nominal; nobody troubles to enforce it. The Catému valley is in the heart of an important wine and *chicha* district, where alcoholic beverages are plentiful and cheap. Those who know the Chilean workingman's great failing—his inordinate love of alcohol—will admit that the handling of labor under such conditions is difficult. Yet the men caused little trouble. Chilean laborers when drunk are very quarrelsome, but fortunately they are content to fight among themselves; it is exceptional for an engineer in Chile to get attacked by his own men. Even when mad with drink their behavior toward their chiefs is respectful and considerate. The Chilean *roto* seems to have a profound contempt for life, so that quarrels nearly always end fatally. The greatest inconvenience that the engineer will experience will arise from the reduction in numbers on Mondays and after fête days. 'Sacking' and fines will prove of no avail; the new men

will turn out to be as bad as the discharged ones. I avoided this trouble by giving, to any man who asked for leave, two days per month to go and get thoroughly drunk, provided he supplied a substitute. This arrangement, immoral though it was, worked splendidly; I strongly recommend it to anyone who finds himself in the same predicament, and who is not above making use of it. If Chile were to go 'dry' the efficiency of labor would increase at least 100%. Most of the Chilean workingman's failings can be traced to drink. The *roto* fails to turn out on Mondays because he is unfit for work on account of some drinking orgy on the previous night, not because he is lazy.

The Chilean as a rule is a hard worker, but much better results can be obtained from him if he is put on contract or piece-work. On day's pay he is inclined to be slack. He is a mechanical genius, and there is nothing he loves better than to handle machinery. He likes erecting better than the purely routine work of running engines, and for this reason he is inclined to be careless of details, such as oiling. If properly handled he is docile and willing, but he resents, like most of us, injustice, or being called 'black', which he is not. Because of his independent and proud nature he must be led, not driven; yet he must be ruled with a firm hand, for he is quick to notice and take advantage of weakness. Add to these traits his nomad habits and love of adventure and the Chilean will leave a good job for a reason that, in any other country, men would think nothing of.

Bachelors travel from place to place, not to better themselves but to see life. Perhaps this is due in part to a lack of inducement to stop. Many Chilean *rotos* have no possessions other than what they carry on their backs, so they can travel with freedom. The Chilean workingman is improvident, and saves nothing. He will drink or gamble a month's wages in a single night, and will appear at work on the following or the next day as unconcerned and no sadder than usual. One of his better traits of character is his generosity and his willingness to help an unfortunate comrade. There is no case of illness, bereavement, or accident that will not find his purse open for the benefit of a mate.

Foreign engineers coming to Chile should possess a knowledge of Spanish. Some make the mistake of thinking that loud shouting will make up for a deficient knowledge of the language. These fail to understand that it is not the men's sense of hearing that is at fault, but their own ideas of Spanish. Besides, the Chilean is apt to take advantage of a foreigner's bad Spanish, and to pretend he does not understand an order, whereas he understands it well. Outbursts of temper are wasted on him; he considers, and not without reason, an exhibition of temper as proof of weakness and unworthy of a man. That is why, in his quarrels and fights, ordinary insults and oaths are conspicuous by their absence. He believes in deeds, not words.

The Chileans as a nation and individually are obedient and law-abiding. Their political evolution has been peaceful; Chilean history only records three revolutions, which, for the respect for life and private property that all contending parties exercised, together with the high ideals for which they were fought, should be termed civil wars rather than revolutions. In a continent where a revolution is often a cloak for theft, murder, rapine, and brigandage, I think that the peaceful political evolution of Chile deserves to be more widely known and appreciated.

One of the features that will strike a visitor on arriving in Chile will be the lack of gaiety and enthusiasm of the crowds, even in places of amusement, such ar theatres. Only on September 18, the anniversary of Chile's declaration of independence, will the foreigner notice a spark of enthusiasm. For the remainder of the year the people are apparently sorry to be alive. The joy of life seems to be unknown in Chile. The *roto* especially is characterized by his profound sadness and stoic indifference, alike to pain and suffering as to the good things of life. An Englishman, whose phlegm is proverbial, would appear mercurial by comparison with him; with this difference, however: the British phlegm is the product of training and an iron discipline from childhood; that of the *roto* is natural, and inherited from his Araucanian ancestors who, for over a century, kept the flower of the Spanish *tercios* at bay, among the woods and valleys of their country. Perhaps, too, the *roto* acquires his hardihood, cold courage, and fatalism slowly as he grows up to manhood; for, whereas the Araucanians used to kill their defective offspring, in Chile today the law of the survival of the fittest rules inexorably and only allows the strongest to reach manhood. Over 50% of the children born are said to die under one year of age. No wonder then, that those who survive are strong, and will look upon the ordinary happenings of life as things of no moment.

The houses (though it is a misnomer to call four walls a house) where Chilean laborers live are often worse than pig-sties; they are unfit for human habitation. Sanitation is conspicuous by its absence; medical attention and hospitals are either lacking or deficient. Working conditions are deplorable, and safety-first rules are almost unknown. The number of fatal accidents in Chilean mines and industries is appalling, and among the highest on record. In a country where the people are naturally docile, the attitude between capital and labor should be one of friendly co-operation and goodwill, provided that employers and engineers exercise those qualities of leadership, tact, and sympathetic understanding that one is justified in demanding of them because of their superior education and broader outlook. Unfortunately, strikes are becoming the fashion, although a few years ago they were almost unknown. Some of these are inevitable; they are the result of the change that Chile is undergoing.

American and European engineers make the mistake, especially when new to the country, of comparing Chileans with skilled Americans or Europeans. Such a comparison is unfair; many Chileans in industrial occupations were, until recently, farm laborers; they were unused to anything more complicated than a shovel. I

made the same mistake at first in comparing Chileans with the skilled Cornish miners and millmen whose ancestors had been occupied in the winning of tin for over seventy generations. That Chileans appreciate and will avail themselves of better living conditions can actually be seen at the settlements of the Braden Copper Co., at Chuquicamata, or at any other of the mining towns built by American companies. Let us hope, for the sake of peaceful relations between capital and labor, that other mining and industrial concerns will copy the splendid lead in welfare work so admirably given by American capital in Chile.

TABLE VII

Total Costs for 1920

	Total cost	Cost per ton	Percentage of total cost
Superintendence	₱ 8,832.7	₱0.932	6 6
Labor	36,585 5	3.860	27.1
Flotation oils	17,504.2	1.850	13.0
Other reagents	8,772.1	0 925	6.5
Lubrication	2.005.3	0.218	1.5
Hydraulic power	7,428.3	0.782	5.5
Steam power	13,657.6	1.440	10.2
Repairs	7,617.2	0.805	5.7
Balls	6,849.5	0.722	5.1
General expenses	10,978.5	1.160	8.1
Patent	12,396.8	1.310	9.2
Lighting	229.3	0.024	0.2
Assaying	1,163.1	0.122	0.9
Miscellaneous	632.3	0.067	0.4
Total	₱134,652.4	₱14.217	100.0

TABLE VIII

Consumption of Oils and Reagents in the Year 1920

	Bbl.	Total cost	Cost per lb. Centavos	Cost per ton	Lb. per ton
Flotation Oils					
M. S. fuel-oil	37	₱12,519.42	42.0	₱1.33	3.16
Pine-oil	11	3,109.50	71.0	0.33	0.47
Mexican crude petroleum	33½	1,047.36	7.5	0.11	1.47
Coal-tar	6	495.90	21.0	0.05	0.24
Vegetal tar	1	332.02	79.0	0.03	...
Total	..	₱17,504.20	...	₱1.85	5.34
Other Reagents					
Polysulphide	13	₱ 7,999.10	93	₱0.845	0.91
Silicate of soda	5	772.98	28	0.081	0.29
	..	₱8,772.08	..	₱0.926	1.20

TABLE IX

Average results for 1918, 1919, and 1920

	1918	1919	1920
Feed:			
Total copper, per cent	6.30	5.77	4.70
Copper sulphide, per cent	5.35	4.68	4.03
Copper oxide, per cent	0.95	1.09	0.67
Concentrate:			
Total copper, per cent	27.1	24.6	31.1
Tailing:			
Total copper, per cent	1.36	1.06	0.51
Copper sulphide, per cent	0.83	0.59	0.25
Copper oxide, per cent	0.53	0.47	0.26
Extraction:			
Total	82.4	85.1	90.6
Sulphide	87.3	90.0	94.8
Oxide	54.5	65.1	66.2
Cost per ton, Pesos	11.13	14.34	14.22
Cost per kilogramme of copper received, pesos	0.237	0.298	0.334

During 1920 the cost of concentrating 1 ton of ore was ₱14.22; the cost of recovering 1 kilogramme of copper was ₱0.334 or 33.4 centavos.

PROBABLY no branch of the oil industry has been so profitable as the pipe-line companies. These companies are usually engaged exclusively in the transportation of oil at a certain rate per barrel; they avoid all of the hazards of drilling and the refineries' losses due to sudden price changes. Many of the pipe-line systems in the country have been carrying oil for many years and have long since returned the original capital invested.

Device to Prevent Accidents in Hoisting

By J. J. Bourquin

*Many of the largest coal mines of the United States are in Illinois and Indiana. At these mines it is not uncommon to hoist, from a single two-compartment shaft, 3000 to 5000 tons of coal during an eight-hour shift. The mines are equipped with the most modern hoisting-engines, some of which operate with maximum rope-speeds varying from 3500 to 4500 ft. per minute. The hoisting-engine at one mine is equipped with a comparatively simple device which can be applied to any steam hoisting-engine, and which eliminates in a large measure the possibilities of accident.

This apparatus is not complicated in its details. The drum of the hoisting-engine is equipped with a band-brake that can be operated either by a foot-treadle or by a valve admitting steam to a small steam-cylinder, the piston of which acts on the lever of the foot-treadle. This band-brake and the means for applying it are common to all ordinary steam hoisting-engines. A large and powerful electric magnet sets on the floor of the engineer's platform a short distance in front of the engineer's post. A bent lever is pivoted to a fulcrum just back of this magnet; one arm of this lever carries an iron block which is attracted to the magnet whenever the magnet is energized by the closing of an electric switch on the shaft bottom. The other arm of the bent lever is connected by a system of links to the valve that governs the admission of steam to the cylinder operating the band-brake. The controlling device for the throttle valve of the hoisting-engine is operatively connected with a piston arranged in a second steam-cylinder to which steam is admitted by a pipe that is tapped into the steam-supply pipe carrying steam to the cylinder that operates the band-brake. The junction of these two pipes is just below the valve that governs the admission of steam to the cylinder operating the band-brake; hence the opening or closing of this valve controls the admission of steam into both cylinders. Whenever the magnet is energized, the iron block on the one arm of the bent lever is attracted to the magnet instantly, the system of links or levers connected to the other arm of the bent lever opens the valve admitting steam to the two cylinders, the band-brake is applied, and the controlling device for the throttle valve moves in the direction to close the throttle valve. Thus the hoist stops instantly.

A knife-switch mounted on the timber which supports the brow-timber between the two compartments of the hoisting-shaft on the shaft bottom is used for governing the electric circuit that energizes the magnet at the hoisting-engine. In this position the switch is immediately accessible to the cager should trouble occur on either cage. A plate of insulating material about five inches wide by six inches long is attached to the handle of the switch, and this enables the cager to close the switch by simply striking the plate with his hand.

*Abstract from Reports of Investigations, U. S. Bureau of Mines.

Milling Asbestos Ore in Quebec

By Wynant D. Hubbard

Introduction. The separation of asbestos fibre from the rock in which it occurs is an art differing in almost every essential from the common practice of mineral separation. To separate the fibre without breaking it requires machinery and processes that are used in no other mining industry.

Crysotile asbestos is found in veins of compact crystals, of the composition $H_4Mg_3Si_2O_9$, in most cases at right angles to the length of the vein. It is also found along planes of movement as a thin and matted coating. The veins, in most cases, do not exceed 2 inches in width, although extreme widths of 3, 4, or even 5 in. have been found. The majority of veins contain a core of magnetic or chromic iron, forming two veins of asbestos, one on each side of the core. This is particularly true of wider veins. To rid the asbestos fibre of these iron minerals is one of the difficulties of milling.

Asbestos is marketed in two well-defined classes, which in turn are subdivided into grades. The first class, or 'crude', is divided into two grades: No. 1 consists of fibre measuring 1 in. or more in length, and No. 2, ½ to 1 in. This 'crude' is produced by hand-cobbing, which consists in knocking off the walls of the vein with a small iron mallet; and, if there be a centre core of iron, the separation of this from the asbestos by further pounding. Considerable gangue adheres to the fibres, but the manufacturers take it in this form.

The second class, or 'fibre', is produced by the milling. Different grades such as 'B', 'C', 'shingle-stock', 'cement-stock', and 'floats' are produced, and are graded and sold in accord with tests to be described later. The care taken to procure such crude asbestos or long fibre may be understood when the enhanced value is considered. When 'B' fibre is selling at, say, $400 to $800, 'C' at $275 to $400, and 'cement-stock' at $17.50 to $30, No. 1 fibre would be worth $1700 to $2000 and No. 2, $1200 to $1500. The portion of the product of a mine that is 'crude' varies in different localities, but it is not likely to be more than 0.25 to 0.75% of the total.

Milling comprises four main processes: crushing, drying, screening, and the suction of the fibres from the screens, the last process being the real and ultimate separation. These will be studied in detail as found in the mills, which are commonly of the two-section type, that is, comprising a crushing and drying section and a crushing, screening, and suction unit.

The Crushing and Drying Section. Large crushers are seldom seen in asbestos mills because the type of ore-handling machinery in the pits does not permit the economical handling of large pieces. Jaw-crushers 15 by 30 in. or 24 by 36 in. are common. Gyratory crushers are seldom used as primary breakers. Considerable discussion has arisen over the comparative suitability of jaw- or gyratory-crushers for primary breaking. Some claim that the angle of nip of a gyratory crusher is such that it injures the fibre; others, equally well informed, claim that the jaw-crusher is as injurious to the fibre. An investigation of the work of both types on asbestos-bearing rock, leads me to the conclusion that jaw-crushers are less injurious to the contained fibre than are gyratories.

Rock fed into a gyratory crusher has a marked tendency to slide upward and jump, an action that is likely to break the fibre. This jumping tendency can be prevented somewhat by choke-feeding, but the regulation of feed to a primary crusher is difficult. Ore in a jaw-crusher does not jump or slide as in a gyratory crusher, because of the corrugations on the crushing-plates and because of the direction in which the crushing force is applied. A jaw-crusher breaks rock almost entirely by a direct squeezing force; a gyratory, as its name connotes, gyrates, and therefore breaks the rock by a twisting motion rather than by a direct squeeze. This twisting motion, however slight, exerts a pulling force on the rock that often results in broken fibres.

Jaw-crushers are also more economical to operate than gyratory crushers unless a large amount of rock is put through the mill. The following table illustrates this point, with crushers suitable for a 700-ton mill:

	Size of receiving capacity, in.	Approximate capacity in 10 hr., crushing to 4 in., tons	Hp.
Jaw	24 by 36	700	50
Gyratory	24 by 84	2100	140

Secondary crushers, however, are usually of the gyratory type. The feed is about 4 in. and this can be regulated so that the crushers are nearly always choke-fed. This prevents a large part of the jumping referred to above. The twisting motion, however, results in a reduction of the grade of fibre. Jaw-crushers could, of course, be used for this secondary work, but a gyratory is more economical to operate from the point of view of power consumption.

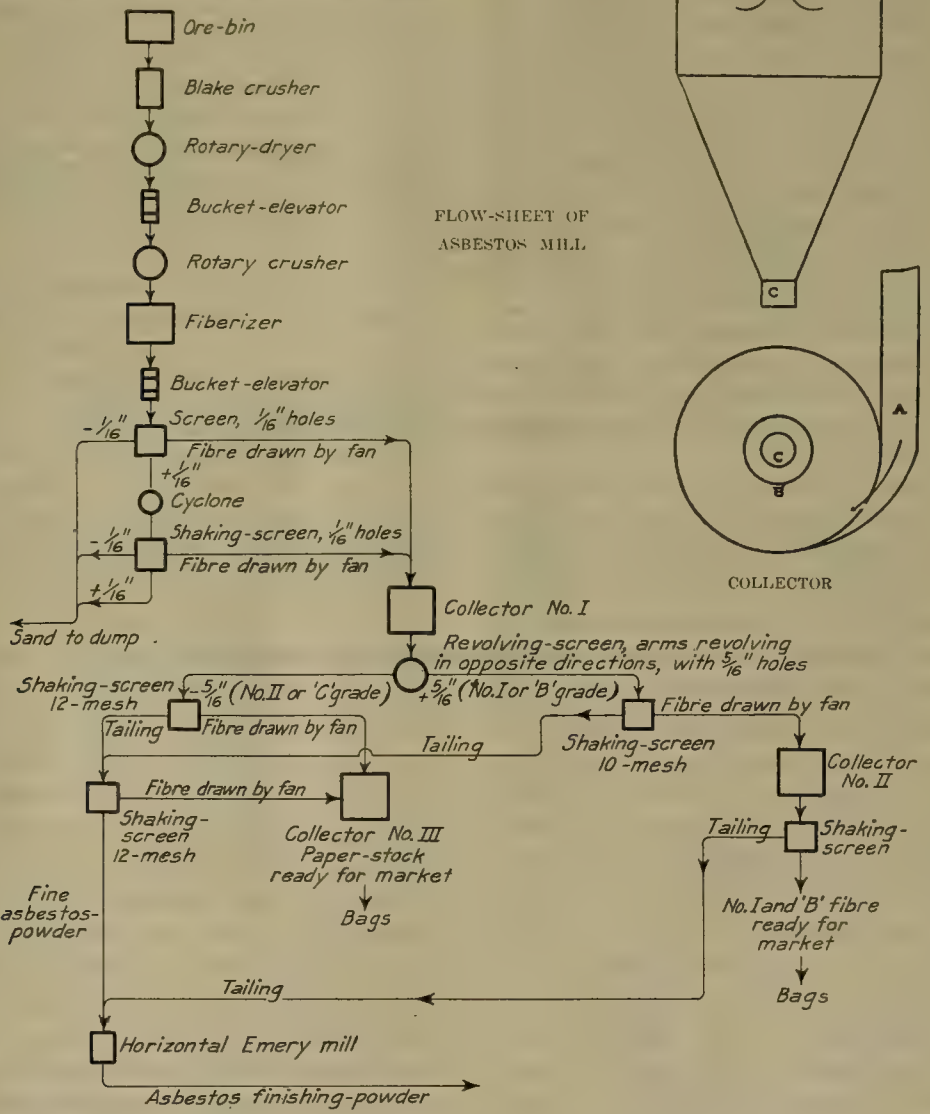
	Size of receiving capacity, in.	Approximate capacity in 10 hr., crushing to 2 in., tons	Hp.
Jaw	8 by 14	85	12
Gyratory	8 by 34	200	20

From the above it can be seen that a battery of two jaw-crushers would not equal in capacity that of one gyratory. The gyratory product is also of a more uniform size.

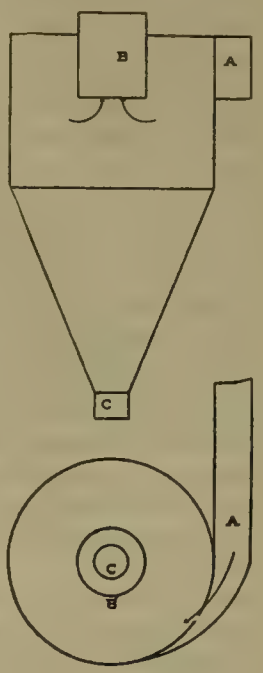
Rotary-crushers were introduced in some of the mills to take the product from the primary breakers. The Butterworth & Low rotary-crusher, which was used generally, is a heavy machine of the coffee-mill type. It

consists of two parts, the upper one for coarse crushing and the lower one for fine crushing. The machine will take feed up to 6 or 7 in. and will reduce it to ¼ in. if desired. It has a capacity of 7 to 13 tons per hour and requires 8 to 11 hp. Millmen claimed that this rotary-crusher was efficient; and, because of its drop-base, easy to clean and keep in repair. All the crushing surfaces are of hard chilled iron. It is not now used.

Attention has been given to rolls as secondary crush-



FLOW-SHEET OF ASBESTOS MILL



COLLECTOR

ers because the crushing force is almost a direct squeeze, with little pull. Experiment, however, has shown that the fibre resulting is so compressed that later separation by screening is rendered far more difficult than if the ore had been broken in gyratory crushers. Ore coming from the primary crusher is usually dried before secondary crushing; this drying is an essential preliminary to the later processes of screening and sucking. There are three types of dryers in use: the single-tube horizontal dryer, the multiple-tube horizontal dryer, and the vertical dryer. The single-tube horizontal dryers are of the rotating single-shell type, with a fire-box at one end. Double-shell dryers are coming into general use; their efficiency is much greater. The multiple-tube dryer, made by the Campbell company, of Sherbrooke, Quebec, is more efficient than the single-tube. Instead of one tube, this dryer consists of five small tubes, each 15 in. diam., running parallel to the main axis. The usual size is 4 ft. 6 in. diam. by 35 ft. long. A one-tube dryer of 4 ft. diam. and 35 ft. long has a drying-surface of 439 sq. ft., compared with 714 sq. ft. in the multiple-tube Campbell dryer. This dryer does about 1.62 times as much work as the single-tube dryer for the same amount of fuel.

The Amalgamated Asbestos Corporation uses a ver-

tical or tower-dryer about 40 ft. high. To prevent the ore from dropping through the dryer too fast, steel rails are placed inside in a criss-cross fashion; the set of rails nearest the top runs at right angles to the set immediately below. This dryer is economical to operate from the point of view of consumption of coal and of repairs.

In tower-dryers, however, there is difficulty in controlling the rate of feed. On warm dry days, rock can be passed through the dryer faster than on wet muggy days; it is profitable to take advantage of this fact. On first consideration, tower-dryers would seem to be far more efficient than those of the horizontal type, and this would be true if a satisfactory method of controlling the feed and the rate of passage of the ore through the dryer could be proposed. Many types have been developed and patented, but in none has this difficulty been overcome. The most satisfactory type so far developed is that in which the speed of the dropping ore is controlled by changing the angle of the baffle-plates. This baffle-plate dryer is economical of coal; the hot air passing upward collects under each plate, keeping it at a high temperature even in winter. The plate-dryer is objected to, however, on the ground that clammy asbestos falling from one baffle to another has a tendency to mat and stick. This can be overcome to a large extent by changing the angle of the plate.

The Crushing, Screening, and Suction Section. From the secondary crushers the ore is elevated to an intermediate bin, after which it is further reduced. It is at this stage that one of the greatest problems in asbestos milling arises: how to break the dry ore from 2 in. to opproximately ¼ in. without injuring the fibre. Four different machines are doing this work. The oldest and most common is the Laurie cyclone. In this machine the beaters or impellers are revolved at a maximum speed of 1900 r.p.m. One is revolved clockwise, the opposite one counter-clockwise. The ore drops upon the beater nearest the opening. It is struck by a blade and thrown with great force against the walls of the chamber. It bounces back or drops into the bowl, and is caught and thrown again until it is struck by the beater opposite the feed opening, which is revolving in such a manner that it discharges all material struck by it.

This machine has many defects. Unless it is fed lightly, broken ore accumulates in the bottom of the bowl and is subjected to a beating and grinding action that is injurious to the fibre. Any tramp-iron entering the cyclone causes damage. A nut falling on a beater is thrown against the sides of the machine with sufficient force to break the cast-iron liners. The pieces of the broken liner are in turn hurled around until the whole machine, which is made only of cast-iron plates, is badly damaged, if not smashed. The power necessary to run one of these machines is greatly out of proportion to the amount of work accomplished; 65 hp. should run a crushing machine of greater capacity than 15 tons per hour.

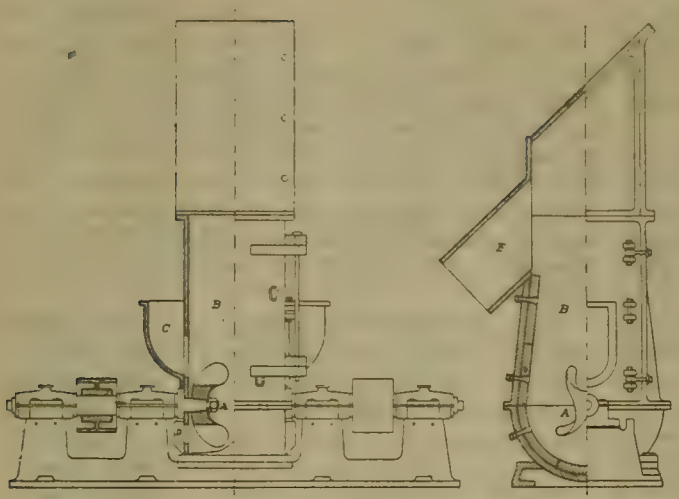
Because of frequent breakage, these Laurie cyclones are extremely expensive to maintain in repair. In all mills using them, large stocks of beaters, shafts, and other parts are kept on hand because of frequent breakdown.

The second type, found in only a few mills, is the swing-hammer crusher or pulverizer, which finds its chief use in cement-mills, where it is desirable to grind rock to a dust and where the rock contains no mineral that may be injured by such grinding. The semi-circular grizzley that regulates the size of the discharge opening is the main cause of trouble when this machine is used to reduce asbestos rock. The particles that are not broken fine enough to pass the grizzley are dragged across the bars and again carried around the machine. This results in chopping the fibre. The machine is also subject to break-downs from the presence of tramp-iron. Swing-hammer crushers require a large amount of power. When fed with 3-in. rock at the rate of 15 to 20 tons per hour, a swing-hammer pulverizer requires 100 horsepower.

The best machine for this difficult work, and the only one that has been designed solely for asbestos-bearing rock, is the Torrey cyclone—a vertical-type crusher that operates as follows: Ore is fed through the opening and falls on a wearing-plate of manganese-steel. From there it bounces and is caught by the vanes or horizontal impellers, which are revolving at from 1100 to 2000 r.p.m. The ore is hurled from these vanes into manganese-steel jaws. The impact is sufficient to break the rock and liberate the fibre without cutting it. For greater efficiency, another set of vanes revolves below the first, and the hurling and breaking action is repeated.

This machine has great advantages over the other two types. It breaks the rock without injuring the fibre, an action which can be accomplished only by impact breaking. It has a tendency to fluff the liberated fibre, which helps greatly in the succeeding screening processes. Because of the manganese-steel jaws and the wooden casing, which acts as a shock absorber, tramp-iron can do no damage. Moreover, tramp-iron entering the machine does not hit the vanes as they revolve, but slides with them. This has been proved by the passage of bolts, nuts, and bits of drill-steel through the machine without breakage. The vertical shaft hangs from a ball-bearing race, so that little power is required to operate it. A 17-hp. motor will run one Torrey cyclone efficiently for an output of 12 to 15 tons per hour.

The fourth type of machine is the Jumbo or 'fiberizer'. This consists of a horizontal cylinder of steel plate with cast-iron heads, and with liners made of steel plate. The cylinder is in halves, which are hinged together to facilitate opening for cleaning and repair. Through the centre of the cylinder runs a shaft with eight arms of heavy bar-steel, carrying on the ends chilled-iron beaters, the faces of which are at such an angle that the material fed into the machine is driven to the discharge-end as the shaft and arms are rotated. The shaft is geared to make about 300 r.p.m. This machine, made by the Jenckes Machine Co., of Sherbrooke, is used in a number of mills, and gives satisfaction. Less attrition results than with

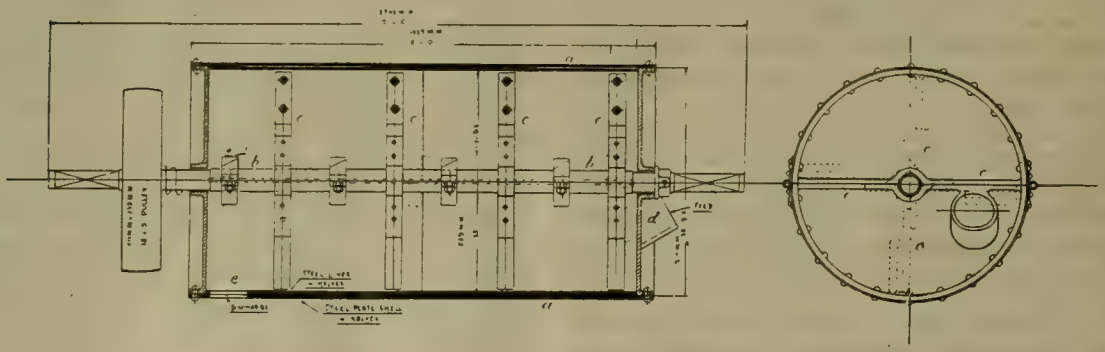


CYCLONE FIBERIZER, MANUFACTURED BY THE LAURIE ENGINE CO.

by a rotating motor placed beneath. This swift vertical motion (3600 vibrations per minute) keeps the asbestos fibre in suspension above the screen cloth, and allows the sand to pass through quickly. This results in the production of a cleaner grade of fibre and permits the separation of a large tonnage per screen.

The screens are arranged in series of two, each of the same mesh (see flow-sheet). Three series are usually used, the first two being 10 by 10-mesh, the second 12 by 12, and the third 16 by 16. The undersize from the first series of screens goes to the second series, and so on.

The fibre in the material that comes from the top of each screen is sucked up through pipes by powerful fans. These suckers are adjusted by the tightening or loosening of a nut on a long screw fastened at the top to the suckers and at the bottom to the screen. The fibre sucked from the screen passes through pipes to collectors, where the useless dust is extracted. From there



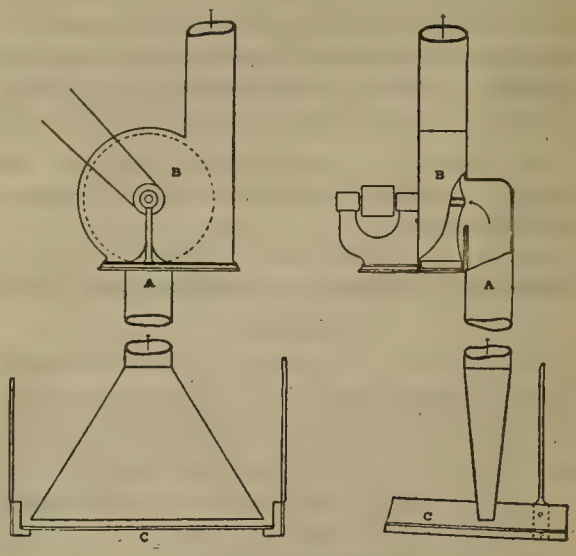
FIBERIZER MANUFACTURED BY THE JENCKES MACHINE CO., SHERBROOKE, QUEBEC

the Laurie machine, but it is not as efficient.

In some mills the tailing is ground to a powder for use in plastering. This is done usually in vertical or horizontal Emery mills of the common direct-running type. The advantages of these mills, in regard to ease of adjustment and low power-consumption, are well known.

The screening of asbestos is another problem. Flat shaking-screens are used in every mill but one. These screens are generally 4 or 6 ft. wide and 10 or 12 ft. long. The material that is fed to the screen is a mixture of asbestos fibres of different lengths, sand, and fine gravel. The screens separate the sand from the fibre. Perforated metal is used in some mills instead of wire-mesh because it is less susceptible to clogging. The horizontal motion of these flat screens, which slides the sand and fibres back and forth on the plates, is not conducive to a clean separation, because the asbestos fibres have a tendency to clog the holes.

A new type of screen, the Mitchell, has recently been tested in the King's mill of the Amalgamated Asbestos Corporation. The tests were successful, and Mitchell screens are being installed. The motion of the Mitchell screen is chiefly a vertical one, the force being exerted



FAN FOR TAKING UP FIBRE FROM SHAKING-SCREEN

it falls to the graders, which are revolving octagonal or hexagonal screens. The undersize goes to the mill floors below for further screening and the oversize passes to the bagging-room. There is a grader for each grade of fibre produced.

The fans that supply the necessary suction are of the usual high-speed type. They require about 50 hp. each. The fibre that comes to the bagging-room is tested every 15 min. The man conducting the tests grabs a sample of about 1 lb. from the piles of fibre and takes it to the testing-room. There it is put in the testing machine, which consists of a set of box-screens about 2 ft. long by 1 ft. wide, and 4 in. deep. There are about three of these boxes, one on top of the other, with a pan at the bottom, the top box having a screen of larger mesh than the one below. The fibre is put in the top screen-box and the three boxes and pan are locked to a mechanical shaking machine, which automatically stops after a run of three minutes. The boxes are then taken out, and the fibre left in each screen is weighed. In this way the fibre is graded. Thus 1 lb. of fibre that has been tested with the result that 1 oz. was left in the first box, 3 oz. in the second, 5 oz. in the third, and 7 oz. in the pan could be called 'fibre 1-3-5-7' test, but is usually sold either as grade 'B' or 'C' or as a product that is known as 'shingle-stock'.

From the above it can be seen that, although the separation of asbestos from rock is a comparatively simple process compared with the treatment of ores of the metals, yet it is one that requires special study and, above all, special machines, It is from this lack of special machines that asbestos milling really suffers. Machines used in entirely different mill processes but that appear adaptable to asbestos milling generally give poor results. The Torrey cyclone is the only machine that has been designed for the purpose; only a few managers have adopted it, but those who have are strong in praise of its work. An engineer who would make a specialty of asbestos mining and milling, giving his attention to the design of a good dryer, good screens, and suckers, or perhaps an entirely different method of fibre separation, perhaps by blowing or by using gravity, would do much for a young and growing industry that greatly needs such help.

The flow-sheet and drawings that accompany this article are reproduced by courtesy of the Department of Mines of Canada.

Loose-Leaf System for Field-Maps and Notes

By John L. Rich

*The equipment for a system of field-maps and notes that, after several years use, I have found to have many advantages, consists of a 5 by 8-in. clutch binder, preferably hinged only on the front cover and opening along the 5-in. side; one or moore loose-leaf binders for 5 by 8-in. paper, punched along the 5-in. side; and a supply of loose-leaf co-ordinate paper. That which I am using is ruled into $\frac{1}{8}$-in. squares, but $\frac{1}{10}$-in. squares would, perhaps, serve as well. The system permits both maps and notes to be carried in the same container—a 5 by 8-in. clutch binder that fits readily into the pocket; it preserves the maps from the wear and soiling to which field-maps are usually subjected; it permits ready cross-reference between maps and notes without burdening the former with reference marks; and both maps and notes may be assembled in permanent loose-leaf binders, and classified and arranged in any way the engineer may desire.

When one of the U. S. Geological Survey topographic sheets is being used as a base-map, the map is first cut into nine sections along the parallels and meridians. These sections fit readily into the note-book. Each section is mounted on a sheet of ruled loose-leaf paper in such a way that the top and left-hand sides coincide with ruled lines on the paper. Glue or rubber cement may be used for mounting. The latter has the advantage that it does not cause buckling and is not affected by water. The sections of the map are designated by an initial letter or abbreviation for the name of the sheet and a number for each of the nine sections, numbered from left to right from the top down. Thus the upper right-hand section of the Atoka sheet would be 'A-3'. The lower left-hand section would be 'A 7'. This designation is placed at the lower right-hand corner of the sheet. On the side margins of the loose-leaf sheets, outside the map, the squares of the cross-section paper are numbered from the top down. Only every fifth number, 1, 5, 10, etc., is actually set down. This furnishes one of the co-ordinates for locating positions on the map. The other is furnished by a 'cover-sheet', which is simply a blank sheet of the co-ordinate paper, along the bottom of which the co-ordinate squares are lettered from left to right, beginning about as far from the left-hand margin as is the left-hand edge of the map.

The sheet carrying the section of the map to be used is placed in the front of the binder, with the cover-sheet over it. The notes may be kept in the back of the binder, together with sections of the map not in immediate use. To make reference to a location on the map it is only necessary to slip the cover-sheet up until its lower edge is on a point desired and is parallel to the lower edge of the map. Then, if the zero of the lettering of the cover-sheet be placed at the left-hand margin of the map, the co-ordinates can be instantly determined. The location is recorded in the notes as 'A 3, 10 j', 'A 7, 26 p', etc. This gives the location to the nearest $\frac{1}{8}$-in. square without making any mark upon the map. If closer location is necessary, a dot on the map may be used. Even a small dot can readily be found at any time by reference to the co-ordinates of the imaginary square in which it occurs. In the office, the location of any point referred to in the notes can be found instantly, even on an uncut map, by lettering and numbering a card to correspond with the co-ordinates that are used in the field and by using the parallels and meridians as guides for the various sections.

*Abstracted from 'Economic Geology'.

Rock-Drilling Tests in the Tri-State Mining District

By C. R. Forbes

*During the past few years the question of rock-drills, drill-bits, and drill-steel have received much attention, and many improvements have been brought about, both in the design and in the use of such equipment.

Among these improvements the use of smaller changes in gauge between successive pieces of steel has been one of the most important. With the old types of piston-drill, gauge-changes of ¼ in. or more were often used, necessitating the use of steel of from 3 to 3½ in. diameter to start, when deep holes were to be drilled. As the work of drilling varies almost directly with the quantity of material removed, the use of these large sizes of steel resulted in a great loss of time and energy. Until the development of the Carr bit and the modern double-taper bits, gauge-changes less than ⅛ in. were deemed impracticable. At the present time many companies throughout the United States are successfully using gauge-changes of $\frac{1}{16}$ in. and in some places changes of only $\frac{1}{32}$ in. are used. Although these small changes require great care and accuracy on the part of the drill-sharpener, both in forging and gauging the steels and in proper heat-treatment, still the cost of this extra work in the drill-shop is more than offset by the increased efficiency of the drilling machines.

Another improvement in drilling practice, which has been brought about recently by several companies, is the use of 1-in. steel in place of 1¼-in. in the large mounted hammer-drills. In the Michigan copper-mining district 1-in. hollow hexagon steel has been used for some time in place of 1¼-in. round steel. This steel is used in drills with anvil-block chucks, requiring no collar or lug on the steel. The Copper Queen mine of the Phelps Dodge Corporation has lately standardized on 1-in. round lugged steel for all machines. The advantage of the smaller cross-section consists in the saving in steel, faster drilling-speeds, and saving in labor on the part of the miner in handling the lighter steel.

In order to find out whether or not these improvements were applicable in the Missouri-Kansas-Oklahoma districts, the Mississippi Valley Experiment Station of the Bureau of Mines, working in co-operation with the Missouri School of Mines, conducted a series of experiments extending over a period of four months, beginning May 1, 1921.

The tests were made by I. F. and J. T. Hodges, senior students from the Missouri School of Mines and Metallurgy, who had had considerable practical experience as miners. The work was done in the Bluebird mine of the O. M. Bilharz Mining Co. near Commerce, Oklahoma, and was under the immediate supervision of F. H. Gartung, superintendent for that company.

The kind of data recorded in the tests is shown by the following headings from a specimen data-sheet.

Length of steel	Distance drilled	Time drilling in	Time drilling out	Speed of drilling, in. per min.	Gauge: At start	Gauge: At finish	Gauge: Loss	Air-pressure	Character of ground	Condition of used bit	Remarks
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

The first series of tests was made to find out the minimum change of gauge practicable for conditions in this district when using the standard 1¼-in. steel.

A study of the practice in the district indicated that gauge-changes of from ⅛ to ¼ in. were commonly used. Drilling is done almost universally with the mounted type of hammer-drills operated by two men; 1¼-in. round hollow steel is used with 24-in. changes in steel lengths.

In order to insure perfect uniformity in the hardness of the bits, a Sullivan oil-forge with pyrometer-control was used for heating the steel. The critical temperature of the steel was determined, and all bits were hardened by plunging from this temperature. The bits were forged on a Sullivan sharpener. Two types of bits were used, the Sullivan double-arc and the cross-bit, both having the double taper. Bits were forged and hardened by the mine blacksmith and were exceptionally well made and uniformly hardened.

The results of this first series of tests showed an average gauge-loss of 3/32 in. for a 24-in. change of steel. In these tests 64 holes, varying in depth from 3 ft. to 12 ft. and totaling 303.5 ft., were drilled. Three different makes of drills were used. Air pressures of from 60 to 85 lb. per square inch were used in drilling.

These results indicated that changes smaller than ⅛ in. would be impracticable. However, to verify this, three sets of 1¼-in. steel were made using $\frac{1}{16}$-in. drop in gauge. The results of these tests indicated that it was possible to use $\frac{1}{16}$-in. drop in gauge in loose water-course ground; but when a hard boulder or hard ground was encountered, the points wore off quickly and caused trouble in changing to the next steel.

The conclusion from all these tests was that for conditions in this district, when using 1¼-in. hollow steel and a 24-in. change in steel-length a gauge-drop of ⅛ in. is the smallest practicable. Larger changes than ⅛ in. are unnecessary, as in no case was the loss greater than ⅛-in. Under these conditions a starter of 2½-in. diam. will permit a 16-ft. hole to be bottomed with a steel of 1⅝-in. gauge. The 24-in. change in length of steel in general use

*Reports of Investigations, U. S. Bureau of Mines.

in the district is quite satisfactory, as in most ground the steel does not become too dull for efficient drilling in penetrating that distance.

The second series of tests consisted in using 1-in. steel in place of 1¼-in. In order to conduct these tests it was necessary to equip one of the standard drills with a special chuck for 1-in. steel. Through the courtesy of the Ingersoll-Rand Co. a special anvil-block chuck for 1-in. hexagonal steel was provided. A simple steel retainer was made at a local shop and attached to the drill. The steel was collared similarly to 'jackhamer' steel. The 1-in. hollow hexagon steel was first tried, because it was the only 1-in. steel available. The use of lugless or collarless steel with anvil-block chucks was thought to be impracticable for this district. The rock is mostly chert or cherty shale. The chert is often much fractured and in some cases along the water-courses is in the form of a loosely cemented breccia. Also the chert varies in hardness. That which is known as the primary or light-colored chert is comparatively soft and brittle and is called 'shelly flint' by the miners. The secondary, or dark-colored chert, is very hard. When drilling a hole which penetrates both kinds of chert the 'shelly flint' will shell-off into the hole and cause much trouble in removing the steel. Along the water-courses small cavities are common. These interfere greatly with drilling, causing a loss of water and accumulation of cuttings behind the bit. Another source of trouble is the dropping of small flint pebbles into the hole behind the bit. These pebbles wedge themselves between the steel and the rock and often cause great difficulty in removing the steel from the hole. A miner frequently spends a great deal more time backing the steel out of the hole than in 'drilling-in'.

In view of these conditions it was decided that 1-in. round lugged steel would be the best section to use. However, as no 1-in. round steel was on hand and sharpener parts were not available for sharpening the 1-in. round steel it was decided to use 1-in. hollow hexagon, which was on hand and could be used immediately. In the meantime parts for the sharpener and a chuck for 1-in. round steel were ordered from the Sullivan Machinery Company.

The results of the tests with 1-in. hexagon steel were most encouraging. Nineteen holes from 4 ft. to 10 ft. deep were drilled, with a total depth of 96.9 ft. The longest steel available for these tests was 10 ft. The starters were 1⅞-in. diam. and $\frac{1}{16}$-in. gauge-changes with 2-ft. changes in steel lengths were used. The drilling was done in different kinds of ground, including the hard flint, water-course, and fractured ground. The drilling speed as compared with previous results with 1¼-in. steel was increased about 90%. The greatest advantage of the small steel, however, seemed to be in the ease with which the steel could be removed from the hole. This fact was evident in every test. The $\frac{1}{16}$-in. drop in gauge was sufficient except in very hard ground where it was necessary to use two steels of the same length in drilling the 24-in. change. The only disadvantages noted with this steel was in cleaning and loading the holes. In the fractured ground where the sides of the holes are rough it was sometimes quite difficult to get the powder into the bottom of the holes.

The conclusion from the results of 1-in. hexagon steel was that holes up to 10 ft. in length can be drilled faster and with much less exertion using 1-in. steel, than when using 1¼-in. steel.

After considerable delay a quantity of 1-in. round steel was obtained from New York by express. Thirty-eight holes, varying in depth from 4 ft. to 16 ft. and having a total depth of 315.7 ft., were drilled with the 1-in. round steel. The results obtained with this steel were not so good as with the hexagon steel. The chief reason for this was on account of the quality of the steel itself, which was of low carbon content and could not be made hard enough to stand the work. The most careful heat-treated bits wore down in a few inches of drilling. The drilling speed obtained with the 1-in. round steel was no greater than with 1¼-in. steel. In making up this steel a 1$\frac{3}{16}$-in. starter was used with $\frac{1}{16}$-in. gauge-drops, making a 16-ft. steel of 1¼-in. gauge. Several 16-ft. holes were drilled in bad water-course ground and much trouble was experienced in removing the steel and in cleaning and loading the holes after the steel was removed. However, it may be stated that much trouble would also have been experienced in the same ground with 1¼-in. steel.

In all the tests on 1-in. steel, both with hexagon and round, there was practically no breakage. Also there was apparently no greater wear on the machine-hammer than with the 1¼-in. steel.

The possibility of using smaller steel in this district is complicated by the method of mining which requires the drilling of many deep holes, and also by the character of the ground.

The use of deep holes necessitates large starting bits. With 1-in. steel a bit larger than 2-in. diam. is undesirable. This means that a 16-ft. hole must be cleared with a bit not to exceed 2-in. diam., which makes it more difficult to keep the machine lined up and also causes more trouble in cleaning and loading than where holes are collared with larger starters. This is especially true in the 'cavey' water-course ground.

The results of these tests, which are still being continued, should show beyond question the possibilities of 1-in. steel in this district.

Since the completion of these experiments at the Bluebird mine the Bilharz Co. has continued the tests, using 1-in. hexagon steel with 1-in. round lugged shanks, and is successfully drilling and loading holes up to 16 ft. in depth.

Conclusions. The conclusions are as follows:

1. One-eighth-inch gauge changes and 24-in. changes in steel lengths are best for conditions in this district when using 1¼-in. steel.

2. One-inch steel can be used successfully, with the large hammer-drills for drilling holes up to 10 ft. deep, at a considerable saving in time and energy on the part of the miner. Gauge changes of $\frac{1}{16}$-in. and changes in steel-lengths of 24-in. can be used with the one-inch steel.

DIVIDENDS OF UTAH MINES

Dividends paid by metal-mining companies in Utah during 1921 were the lowest in many years. The banner year was 1918, when slightly over $29,000,000 was distributed. Companies paying dividends during the current year and the respective amounts follow:

Utah Copper Co.	$4,051,225
Silver King Coalition Mines Co.	364,830
Chief Consolidated Mining Co.	176,806
Tintic Standard Mining Co.	117,470
Park-Utah Mining Co.	50,000
Grand Central Mining Co.	15,000
Iron Blossom Mining Co.	25,000
Gold Chain Mining Co.	10,000
Eureka Hill Mining Co.	10,000
Grand total	$4,830,331

FLOTATION-OILS FROM WESTERN PINE

In a report on the possible uses of Western pine-turpentine, the Bureau of Chemistry at Washington says that there is a well developed market in the West for crude pine-wood oils for use in the flotation concentration of ores, but that the volume of rich wood obtainable within hauling distance is small. It is probable that single-retort plants, which can be dismantled and moved when necessary, are most suitable for wood distillation in that section, especially in regions remote from railroads. It says such plants might be owned and operated jointly by a number of settlers. Medium-grade stumps, though more plentiful than rich stumps, could be used in a commercial plant only at a cost less than the cost of such wood per cord—$8.37. The Bureau says the refined pine-oil and the crude oils obtained by distilling Western yellow pine are valuable for ore recovery by flotation and that this is probably the most profitable use to which these products can be put.

CONTEST FOR CONTROL OF ENGELS COPPER CO.

Henry Engels, president of the Engels Copper Co., whose mine and mill are situated in Plumas county, California, has issued a request to the stockholders for their proxies for the forthcoming annual meeting. This request is in opposition to the 'regular' request for proxies made by E. E. Paxton, the company's general manager. Paxton regrets the friction that has been developed, but in justice to the stockholders will make a formal reply in detail to the charges and statements made in the Engels letter. He declares that the charges are without the least basis in fact. The company has not realized an operating profit during recent months, but the loss has been less than the cost of maintaining the property in an idle condition and the position of the company at the present time is incomparably better than it would be after a period of shut-down, according to Paxton. As to the statements regarding freight-rates and power-contracts, the facts are that the terms of both agreements are highly favorable to the mining company.

In his circular letter to the stockholders of the company, Henry Engels calls attention to the fact that his family and himself have been identified with the mine for more than 45 years, although he adds: "For several years past I have been merely a nominal official representing minority interests in the company". Paxton and his associates control two-thirds of the stock. The letter says that the company has been badly managed; that it "has entered into ill-advised shipping contracts with the railroad whereby we are bound to furnish it with a fixed tonnage of ore for shipment monthly"; that the manager has "entered into a patently bad contract for electric power"; that copper has been produced by the Engels company during a period of low prices and ore wasted when it would have saved the company money to have closed down. He finds fault also with the tearing down of the old mill and the erection of a new one, at a cost, he says, of nearly $600,000.

WAR MINERALS RELIEF COMMISSION NOTIFIES CLAIMANTS—POSSIBLE COMPLICATIONS

The status of 'war-minerals' appropriations was placed in serious doubt by Speaker Gillette of the House of Representatives when he ruled that the Appropriations Committee has the right to appropriate from a fund different from the one from which normally the payment would be made. This may be construed as authorizing the payment from war-minerals funds of other war-claims, although assurances were given by representatives of the War Department that the war-minerals fund would not be used in payment of a specific War Department claim, in a debate that resulted in the foregoing Speaker's decision. The War Minerals Relief Commission has advised claimants of the recent Act of Congress providing for more liberal interpretation of the Act, and while the Secretary of the Interior has not officially interpreted the Act, it is said hearings may be had in the absence of such interpretation.

MINING CONDITIONS IN SONORA, MEXICO, ARE IMPROVING

Industrial conditions have been greatly depressed on the west coast of Mexico. The suspension of mining, due to the low prices for copper and silver, and the consequent loss of revenue to the State from taxes, has intensified the condition. Now, however, there is greater activity. Mining operations are being resumed and preparations are being made for new development, according to a 'Consular Report'. Nothing definite can be learned as to when the Cananea Copper Co. will resume active operations, but there is the impression that the company will start soon after January 1. Other mines in the vicinity of Cananea are virtually idle. Active operations are being carried on at El Tramado, adjoining the old Socorro mine. At the Mejia mine, in the northern part of the Altar district, new equipment is being installed. The ore at the Mejia is reported to carry from 20 to 180 oz. of silver. The Aztec Mining Co. claims to be expending about $300,000 on its silver properties near Noria. The San Ignacio and Cabrillo mines, belonging to this company, are considered to be promising. The Cosden Co., of New York, is developing a silver-gold property east of the Alanos district, near the Chihuahua State line. Another property is the El Caiman, north of San Blas. The mine has been lying idle and it must be unwatered. It is a silver property. The mines at El Tigre and Nacozari are operating.

H. W. MORSE ADDRESSES LOCAL SECTION OF A. I. M. & M. E.

The monthly meeting of the local section of the A. I. M. & M. E. was held at the Engineers' Club on December 27, being preceded by the usual dinner. F. L. Sizer presided and, after disposing of business matters of minor importance, introduced H. W. Morse, who gave an interesting résumé of the methods available for the treatment of mixed copper ores, that is, ores in which the oxide and sulphide minerals are 'scrambled' and economically inseparable. The majority of the larger porphyry copper properties in the United States mine ore that contains copper in oxide form to the amount of 0.2 to 0.4%; this is lost during a treatment that has been designed and is only applicable for the isolation of sulphides. As a general rule the loss of copper because of the unsuitability of the ore to the method in practice varies from 4 to 7 lb. per ton. Sulphidizing preceding flotation has been proved practicable and successful in some cases, but cannot be advanced as a panacea for the trouble. Dr. Morse then dealt at length with the practice at the Ajo plant of the New Cornelia Copper Co., which he described as a perfected and standardized operation that would probably find wide application elsewhere, in spite of the high first cost of the installation, which amounted to about $1000 per ton per day. A decision by the Inspiration company was imminent in this connection; the recovery of the oxidized copper in the ore was imperative; it was probable, stated Dr. Morse, that the New Cornelia method would be adopted. The procedure under normal conditions would be to crush to 3-mesh or so, leach in large vats with a dilute solution of sulphuric acid, reduce the ferric iron in the solution in sulphur dioxide towers, and precipitate the copper by electrolysis, which provides a satisfactory and methodical process for the final recovery of the metal in pure form. The residue in the leaching-vats, after adequate washing, would be removed and re-ground to the desired fineness, and treated by either of the approved flotation methods. It is probable that, in the majority of cases, the treatment of the oxidized portion of the ore would be simpler than has been the case at Ajo, where fouling of the solution is unusually noticeable because of the prevalence of deleterious compounds in the ore. Dr. Morse discussed the history and application of other leaching processes, in which either ammonia, sulphur dioxide, or iron salts are used; and dwelt at length on a combination process that has attracted much attention of late. In this it is proposed to grind the mixed sulphide and oxide ore to the fineness necessary for the subsequent flotation of the sulphide minerals, treat the pulp by agitation methods with sulphuric acid to dissolve the oxide copper, add sponge-iron to precipitate the copper so dissolved, and then treat the mixture by a flotation method that would ensure the isolation of the precipitated copper as well as the copper in sulphide form. The Van Arsdale method of precipitating copper from solution at high temperature and pressure by means of sulphur dioxide was described, and attention was drawn to the progress that had been made in connection with heap-leaching. An interesting and informative discussion ensued, in which several of the members took part. In conclusion the chairman mentioned that some dissatisfaction had been expressed at the headquarters in New York at the small amount of material supplied by the San Francisco section for the Institute's publication. Dr. Morse's lecture had been taken down in full and would be sent to New York, where it would eventually appear in 'Mining and Metallurgy'. The meeting terminated with a rising vote of thanks to Dr. Morse.

MINTS ARE COINING SILVER AT RECORD RATES

Silver purchases under the Pittman Act at $1 per ounce have totaled 80 millon ounces, leaving 128 million ounces to be purchased to replace silver dollars previously melted. Of silver purchased $72,178,000 have been coined, leaving 25 million ounces of uncoined stock of Pittman Act silver on hand. There has been melted under the Act 270,232,722 silver dollars. The three coinage-mints have been operated during recent months on an overtime basis, coinage being the third largest in our history, 553,868,492 pieces having been coined. Resumption of coinage of silver dollars last February, after a lapse of 17 years, is referred to by Secretary of the Treasury Mellon as "the most notable event of the year". This coinage was from the stock of bullion purchased under the Pittman Act. Silver-dollar coinage will continue on a large scale during the silver re-purchases and will probably overshadow other coinage. The mints have also resumed coinage of gold on a moderate scale. The coinage-mints have been reorganized, new methods of handling bullion and new processes of coinage being introduced, resulting in expansion of coinage capacity and economical and efficient administration of the mint service. The largest amount of coin and bullion on hand at any period since establishment of the mint service is carried in the coinage-mints and the New York assay-office.

COPPER STATISTICS IN THE LAKE SUPERIOR REGION—RESUMPTION EXPECTED

Since April 1, when the Calumet & Hecla and subsidiary mines closed down, only seven properties have been in operation in the Lake region. Refinery production was 39% of normal, including the output of the Calumet smelters. Of the seven properties in operation, only four are producers, Copper Range, Quincy, Mohawk, and Wolverine. The Seneca, Mayflower, and Arcadian companies are engaged in development work.

Production, refined, for the year is placed at 107,000,000 lb. Of this amount, 45,000,000 was produced the first three months, leaving 62,000,000 for the remaining nine months' period of curtailment. The average per month for the nine months was 6,890,000, as compared with 22,500,000 normally. The monthly average was somewhat increased by an enlarged refinery production at the Calumet smelters in the last two months of the year, principally in November. Copper Range, Quincy, and the Stanton mines will finish the year with no more than normal stocks of metal on hand. Calumet & Hecla, however, still has a considerable surplus in spite of a large volume of sales during the year. These stocks are sufficient at least to prolong the period of suspension of mining operations until spring and when production is resumed it probably will be on a basis of not more than 50% at the start.

ESTIMATED VALUE OF MINERAL WEALTH OF FEDERAL LANDS

Secretary of Interior Fall, in his annual report, gives estimated tonnages of coal, oil, phosphate, oil-shale, etc., under public ownership, together with royalties thereon that may be expected to accrue to the Government. The total royalty is $150,000,000,000, including the following: Ten billion tons of bituminous coal at 10c. royalty, $1,000,000,000; 30 billion tons sub-bituminous coal at 8c. royalty, $2,400,000,000; 50 billion tons of lignite at 5c. royalty, $2,500,000,000; (this does not include coal upon railroad lands, private grounds, and private lands in the public-land States not developed); 700 million barrels of crude-oil at $2, total $1,400,000,000, 12½% royalty $175,000,000; 50 billion barrels shale-oil at $2, total $100,000,000,000, 5% royalty $5,000,000,000; 3½ billion tons phosphate at $4, $14,000,000,000, 2% royalty $280,000,000; 20 million tons potash at $75, $1,500,000,000, 2% royalty $30,000,000; 600 million barrels oil on Indian reservations at $3, $1,800,000,000; and one billion tons phosphate at $4, $4,000,000,000.

ARIZONA

Globe.—Most of the time of the Superior Court during the week preceding Christmas was occupied in hearing testimony in the 'apex' suit of the Iron Cap Copper Co. against the Arizona Commercial Mining Co. Judge Pattee of Tucson was on the bench. Among the exhibits presented by the defendant corporation is an elaborate glass model of the Arizona Commercial mine, with the orebodies outlined in detail, showing the faulting of the veins. This faulting complicates the matter decidedly and may lead to legal determination of issues never before presented to a court. Extralateral rights on mineral in place heretofore generally have been claimed only on continuing as unbroken vein matter. The suit is to quiet title to ores found within the vertical lines of certain Iron Cap claims. Arizona Commercial also has sued, but in Massachusetts, seeking injunction against the Iron Cap, on the claim that the latter already has taken from Arizona Commercial orebodies about 200,000 tons of ore, valued at $3,000,000. This Eastern suit appears to be in suspension until the local suit has been settled. On the stand for two days was Guy N. Bjorge, for several years geologist for the near-by Old Dominion property. He was called by the Arizona Commercial, which also called Albert Burch, of San Francisco; Pat Rose, foreman during the Amster administration; W. S. Sultan, a former superintendent of the mine; H. V. Snell of Globe; and R. H. Boyd, a former superintendent, now with the Copper Queen at Bisbee. Charles S. Smith of Lincoln, Massachusetts, president of the Arizona Commercial company, was present at the hearings. For the Iron Cap, expert testimony was given by Horace V. Winchell, W. H. Wiley of Glendora, and R. H. Hunt of Los Angeles.

CALIFORNIA

Grass Valley.—According to J. M. Fulton, general manager for the Idaho-Maryland Mines Co., the Eureka lode has been uncovered at the bottom of what is known as the Dorsey winze. This winze extends from the 16th to the 19th level. Development shows that the vein is strong and rich. A second discovery of importance has been made in the lowest workings of the mine where an excellent ore-shoot has been opened. These two new developments seem to assure the success of the project of opening the old producer.

Edward Ross and Arthur Maule have received returns from the first shipment of sacked quartz from the Julia Ross prospect sent to the Selby smelter. The net weight of the shipments was 2136 lb. and the two men say the gold and silver contents were thoroughly satisfactory. A prospect shaft has been sunk to a depth of 75 ft., and at 50 ft. drifts are being run.

Iowa Hill.—T. L. Schwab of Iowa Hill has bonded his Truro mine to T. T. Maynard and associates of San Francisco. The mine is on the American river, and a portion of the former river channel lying above the present river bed. A tunnel has already been run to the channel and the new lessees expect to start at once to mine the gravel. The channel is 4000 ft. long. Equipment has been ordered and will be on the ground shortly.

Ore Beds at the Smelter at Cananea, Mexico

La Grange.—The $400,000 dredge of the La Grange Gold Dredging Co. was launched on December 19. The boat contained some 300,000 ft. of lumber and more than 200 tons of machinery will be installed. Commencement of operations will mark the resumption of mining on an important scale on the Tuolumne river.

Masonic.—H. C. Barnes, who recently secured control of the Pittsburg-Liberty property, reports a good supply of medium-grade ore in sight, but his plan is to develop shoots of high-grade, as milling facilities are still lacking.——The Gold Anchor, which is under option to S. L. Perini, is showing free gold in a tunnel which is being run to intersect the main vein.

Randsburg.—The new mill of the California Rand Silver company has been in successful operation for two weeks. The mechanical operation of the plant is said to be exceptionally smooth and the recovery by flotation is 94% of the silver; $10 ore is being milled for the present, but the heads will average between $15 and $20 after the first of the year.

Spring Garden.—Important development work is in progress at the Walker mine. Drifts are being run on the sixth level in headings leading both north and south of the main shaft. The drift to the north is being driven to cut the downward extension of the ore-zone which is said to have been proved by drifting and diamond-drilling on the 300-ft. level to be 900 ft. long. The main tunnel is equipped with 35-lb. rails, and an electric trolley locomotive haulage-system. Locomotives which can haul eight cars, capable of holding three tons apiece, are in use. The shrinkage method of stoping is employed. As high as 35,000 to 40,000 tons of copper ore, containing appreciable amounts in gold and silver, are stored in stopes awaiting shipment. The 250-ton mill of the Walker company, which, compared with the size of the orebody, is regarded as a mere experimental plant, is said to make the highest recovery of any oil-flotation establishment in the United States. The ratio of concentration, which is four or five tons of ore to one of concentrate, is regarded as the lowest ratio in the country. Because the mill-product is practically self-fluxing, concentrates of the Walker mill are highly desirable for smelting processes. An aerial tramway, nine miles long, connects the mine and mill with the Western Pacific railroad.

Weaverville.—The Shasta Dredging Co., which is operating a gold-dredge near Gas Point, in Shasta county, this month took an option on 1000 acres of gold-bearing gravel in the neighborhood of Minersville. Prospecting with drills is to be undertaken in the spring to test the ground. Included in the bonded area are the claims of J. E. McLean.

COLORADO

Black Hawk.—A concentrating and amalgamation plant of 50-ton daily capacity has been completed by the Cornucopia Leasing, Mining & Milling Co. on its Treasure Mountain property at the head of Silver creek, 3½ miles from Black Hawk. Ore assaying from $4 to $25 per ton has been blocked out above the adit. This is estimated at 35,000 to 50,000 tons; it will be mined to meet mill requirements. The tunnel projected to cut the Reform vein entered the new vein after driving a distance of 900 ft. At the junction of the new vein with the Reform ore assaying $30 to $40 per ton was exposed when a cave temporarily stopped work. The Reform vein in the early 90's produced rich ore from surface workings, but the property was idle on account of litigation until about 18 months ago.

Breckenridge.—The find made recently on the Warrior's Mark is holding up; recent assays taken across two feet of ore return 1000 oz. silver per ton. In addition three feet of talc beside the quartz streak assays better than 100 oz. silver.

Creede.—Shipments have been resumed from the Commodore mine.——The Corsair lessees, Comstock & Wells, loaded a carload of $450 grade recently.——Lessees on the Mollie S. are mining and shipping $50 ore.——The December output of the New York, operated by Morgan & Sloan, is estimated at better than 250 tons with an average value of $40 per ton.——The Mid-West Mining Co. has men grading roads and trails to the Resurrection and Mollie S. mines preparatory to hauling in machinery and equipment. A power-plant is to be installed at the Resurrection and grading for the site has been completed.

Cripple Creek.—A bond and lease on the Yellow Bird and adjoining claims on the south-western slope of Gold hill, and a lease on the eighth level of the Rose Nicol mine, Battle mountain, have been secured by the Pisgah Mining & Leasing Co., a Denver company; work has commenced on both properties with Murray Colgin in charge.

The December production from the Cresson mine, Raven hill, will closely approximate 10,000 tons assaying between $12 and $15 per ton. The daily shipments are ranging from 8 to as many as 17 cars daily, the latter number having been billed out one day recently.

Lessees in the Elkton mine are making fair production and about a car per day of mill-ore is sent to the Golden Cycle mill at Colorado Springs.

DeBeque.—Assessment work on oil-shale ground in this section has been completed by the Superior Shale Oil Co. of Des Moines, Iowa, controlling 1680 acres 10 miles from DeBeque on Roan creek, and by J. Emil Nelson, of Minneapolis, who with associates controls 16,320 acres in the Phenol, T.N.T., and North Star groups, on both sides of Roan creek. This shale land is considered as among the most valuable with regard to quantity and quality of the deposits.

Georgetown.—The Gilpin Development Co. has found high-grade ore in sampling the old workings of the Capital mine, a recent test showing better than 6 oz. gold, 58 oz. silver, and 17.60% lead, in a vein at the tunnel-level, opened for a distance of 25 ft. A winze has been started down on the ore.——Gray copper ore containing gold and silver has been opened up on the Bellevue Hudson by the Teagarden lessees. Other lessees are mining and shipping good ore.

Idaho Springs.—The old Treasure Vault mine in Virginia canyon has been taken under bond and lease by a New York syndicate and preparatory work has commenced. New equipment, including a compressor, will be installed and the Treasure Vault tunnel is to be extended under the crest of Seaton mountain.——Workmen are constructing a new flume to the Mattie mine to be completed by the end of January.

IDAHO

Coeur d'Alene.—The Sidney and Nabob Consolidated veins are one and the same, according to Bert N. Sharp, mining engineer, who examined them recently. The vein is 40 ft. wide and contains ore on both sides. The orebody discovered recently in the Nabob lies on the hanging-wall side, the same side as yielded a high-grade lead ore in the Sidney.

Larger rolls and a new ball-mill are being installed at the property of the Sunshine Mining Co. in the Big Creek district. The plant is shut-down while the changes are being made. A new compressor with a capacity of 550 cu. ft. per minute is being installed and the company is putting up a two-bucket tram. The changes in the mill will increase its capacity to 70 tons per day and the tram will enable the company to remove its ores from the No. 3 and 4 levels. This company and the Big Creek Mining Co. are jointly constructing an 11,000-ft. flume to pick up the water used in the concentrators and carry it beyond the intake of the water system of Kellogg.

MICHIGAN

Houghton.—Quincy, it is estimated, will finish the year with a production close to 15,000,000 lb. of copper, as compared with 19,216,070 in 1920. Quincy started to curtail in 1920, owing to the depressed condition of the metal market, and on April 1 of this year made a more drastic curtailment, working on a four-day schedule instead of six. In November there was a return to almost a full-time basis, but forces were not materially increased. During the first three months of the year Quincy produced approximately 4,500,000 lb. Quincy has a wonderful amount of good ground well opened ahead and is in a position to take advantage of marked improvement in the metal market. Both its mills and smelter are modernly equipped, making for the lowest possible costs. The tenor of Quincy 'rock' shows no falling off with depth.

Copper Range, which will produce upward of 30,000,000

lb. this year, is another mine in position to respond quickly, if labor is available, to improved market conditions. A particularly pleasing development has been the steady improvement in the character of the ground opened in Trimountain, where a heavy program of drifting has been in progress throughout the year. Champion rock continues rich, and while Baltic has shown no improvement the average yield for the three mines for the year should be close to 40 lb. of copper per ton of rock stamped.

Mohawk's production for the year is approximately 14,000,000 lb., while Wolverine's output is about 4,000,000. Mohawk is carrying on a normal program of development work and is producing to the capacity of its mill. Wolverine, in addition to regular mining, is engaged in removing the pillars in the bottom levels of No. 4 shaft.

Of the development properties, Seneca is the most advanced and should become a regular producer in the latter part of 1922. Before this stage is reached a new hoist must be installed at the Seneca shaft. In the meantime drifts are being extended north from all five levels of Seneca, in the direction of Gratiot, and the ground on the whole is described as fully up to the average of the Kearsarge lode.

Arcadian Consolidated has resumed sinking in the New Baltic shaft, which will be sunk to a depth of 1060 ft., from which level a drift will be driven south to connect with the 1050-ft. level of the New Arcadian shaft. This drift will parallel the south drift from the ninth level and provide more exact data of the faulted area lying about 800 ft. from the New Baltic shaft. There is no disturbed area up to that point south of the shaft and none to the north, which gives Arcadian a wide copper shoot on both sides of its New Baltic shaft. The ninth level south drift has cross-cut through the fault and is again in good vein matter going south.

Mayflower, in its new operation on the 1450-ft. level, is getting into fairly good-looking ground to the north, although considerable trap is in evidence. The work here will give a better line on the character of the faulted area, which apparently is centred between this level and the 1700. On the 1700, where trap was found after the south drift had passed through a promising long stretch of mineralized ground, the cross-cut is still in the fault.

Extension of the Calumet & Hecla water-system to the company's subsidiary mines to the north, making possible the draining of wells and all surface water, will help to lower pumping costs by diverting the flow of this water away from the mines. The installation of electric pumps generally in all of the mines will further reduce costs.

MONTANA

Butte.—The Barnes-King Development Co. recently announced production for the month of November as follows: Shannon—ore mined, 3078 tons; bullion production, $31,733.52, giving a yield of $10.31 per ton of ore; total development work for the month 138 ft. North Moccasin—the production by lessees was 1422 tons of ore, assaying $5.09 per ton; royalty received on this ore was $476.76; owing to the cold weather, lessees decided to stop mining and milling until next March. Piegan-Gloster—mine not operating. Strawn property—development on this property which is under option, is progressing as rapidly as adverse weather conditions and high altitude will permit.

NEVADA

Austin.—General excitement has been aroused by the reported discovery of carnotite in the Cahill mine in the Birch Creek district. Carnotite is said to be exposed also at a depth of 140 ft. in the Nevada Birch Creek group.

Eureka.—At the Uncle Sam mine an electric-lighting plant, a four-drill air-compressor, and an assay-plant are being installed. Mine machinery, rails, pipe, and fuel-oil have been received, and shipments of high-grade ore will be made during the winter, the ore going to smelters in Salt Lake valley. A mill may be erected in the spring.

Concentrating and Cyanide Plant of the Deer Trail Mining

Lovelock.—F. G. Stewart and associates of Chicago have purchased the gold mining property of E. T. Walker. Stewart has been at Lovelock for several weeks purchasing machinery and necessary equipment for the erection of a reduction plant upon the property. Ground has been broken and a carload of pipe is now at the property to be laid a distance of 6000 ft. with a 400-ft. elevation. The water will be brought from a well and spring to operate the proposed 20-ton amalgamation plant.

The property involved is known as the Old Hagan Hill, two miles north-west of Rochester in Limerick canyon, and 28 miles north-east of Lovelock. It is proposed to have the plant ready for operation by February 1 with E. P. Walker as superintendent.

The 300-ton mill now under construction at Candelaria for the Candelaria Mining Co. will be in operation by spring, according to C. D. Kaeding, consulting engineer. The Mineral County Powder Co. is now building a high-power line to the mines and the mill; William Dunn, who recently completed the installation of the mill at Simon for the Simon Silver Lead Co., is constructing engineer in charge of the mill.

A large amount of low-grade ore now blocked out in the stopes together with ore on the dumps will furnish the first ore for the mill. The building of the mill is being financed by the Rochester Silver Corporation.

Tonopah.—Three men were killed and a score of men were injured, some possibly fatally, in a fire which on De-

cember 22 totally destroyed The Big Ship, a miners' boarding and lodging house owned by the Tonopah Belmont Development Co. The bodies of the three men found in the ruins were identified as L. A. Ballon, Fred W. Johnson, and M. Angosta. They were found at the bottom of a flight of stairs, indicating that the men were trying to escape. So rapidly did the flames spread that the discoverers of the blaze had no time in which to warn the sleepers. Within an hour after the alarm had been sounded the building, measuring 100 ft. in length, 50 ft. in width, and two stories in height, was leveled by the flames. The value of the building was placed at $8500; the loss was covered by insurance. The structure had been a landmark in the camp, being built 14 years ago. In 1914 it was purchased by Mrs. Mary Harrington and conducted by her as a boarding and rooming house until the miners' strike last summer. It was purchased by the Belmont company last month and was used to house some of the company's employees. Under the name, The Big Ship, the house was known in every mining camp in the West. It was originally known as the Celtic, but was later re-named by the miners.

Yerington.—Reports are to the effect that the Mason Valley Mines & Smelter Co. is completing arrangements for addition of a silver-lead unit to its Thompson smelter. The new installation, including reverberatory furnaces, a refinery, and other departments, will represent an expenditure of $500,000 to $750,000. It is also reported that the company plans to manufacture its own coke from the coal exposed in the Darms property near Coaldale. The coal is stated to be excellent for coking, with a large tonnage indicated.

UTAH

American Fork.—The stockholders of the Pittsburg Consolidated Mining Co., at a recent meeting, ratified a deal whereby the Pittsburg Silver Mining Co., a Delaware corporation, secures a lease and bond on the former company's properties in this district, with the privilege of purchasing for $150,000. The buyers have had charge of the property since September, and recently completed a tramway to deliver ore to a loading-station in the canyon.

Bingham.—The United States Mining Co. and the Highland Boy Mining Co. have been getting excellent results from the use of wet stoping-drills, according to C. A. Allen, chief inspector for the State Industrial Commission. These machines feed water to the bottom of the hole and keep the drill-cuttings constantly wet. The Chief Consolidated and Tintic Standard companies at Eureka are among the large metal producers who have recently adopted these drills.

Eureka.—Directors of the Tintic Standard Mining Co. have declared a dividend of 5c. per share, payable December 31. This is the same amount paid during the first and second quarters of the year, and will call for the distribution of $58,735. The grand total of dividends to the close of 1921 is $1,606,167. The chloridizing plant is now precipitating more than 3000 oz. of silver per day and about 1000 lb. of copper. Gold recovery is negligible, but equipment has been ordered that is expected to improve the extraction of precious metal. A recent report states that the reserves of mill-grade ore total 511,000 tons, averaging $12.08 per ton of recoverable metal. The extraction of silver averages from 83 to 85%; of copper, from 50 to 62%. The reserves of straight smelting ore are estimated at 343,000 tons, averaging $34.05 per ton. The total amount of silver in the mine, on the above basis, is 17,000,000 oz. The company has produced $10,000,000 worth of ore in its brief history, all of which has come from an area 700 ft. wide and 700 ft. long.

Ore production from this district for the week ended December 17 totaled 156 cars, as against 176 cars the preceding week. The Tintic Standard shipped 49 cars; Chief Consolidated, 39; Victoria, 12; Iron Blossom, 10; Eagle & Blue Bell, 9; Centennial-Eureka, 9; Dragon, 8; Colorado, 5; Mammonth, 3; Empire Mines, 3; Swansea, 3; Gemini, 3; Bullion-Beck, 2; and Alaska, 1.

Marysvale.—The Deer Trail Mining Co. is one property in the State that continues to produce its regular tonnage of ore. Two classes of ore are shipped direct to the smelter: (a) gold-silver ore, and (b) lead ore. The lower-grade ore is handled in a mill of 100-ton daily capacity by a combined concentrating and cyanide process. The company employs all told from 125 to 135 men. Mining operations are under the deriction of George W. McCaskell, a brother of Jasper A. McCaskell, general manager, while the mill is in charge of Dwight Wadleigh. Recently a suit was filed against the company by A. H. Baldwin, as receiver for the Denver & Rio Grande railroad, for $1179 with interest, alleged to be due the railroad company on ore shipped from the plant to Salt Lake Valley smelters. The company is a close corporation, controlled by the Salisbury estate of Salt Lake City.

Ophir.—The St. Clair lease at the Buffalo mine, on Lion hill, recently shipped a carload of ore to a Salt Lake Valley smelter that totaled 55 tons, netting $32.50 per ton. Assays showed $2 in gold, 47 oz. silver, and 38% lead.

Park City.—It is reported that 4 ft. of high-grade ore has been uncovered recently in an abandoned drift on the 1300-ft. level at the Ontario mine. No work has been done in that part of the property for sime time, but certain indications lead Frank Fleishman, foreman, to do a little prospecting. Results indicate that a large orebody has been found.

Ore shipments during the week ended December 17 totaled 2430 tons, of which the Judge allied companies shipped 1128; Silver King Coalition, 867; and Ontario, 435. Shipments the previous week totaled 2162 tons.

Soldier Summit.—The American Hydro-Carbon Co. has taken over the claims of the Ozokerite Mining Co. The new company has sunk a shaft, which cut a deposit of ozokerite at a depth of 35 ft. A reduction plant is under construction, and is expected to be ready for operation by spring.

WASHINGTON

Colville.—Silver ore said to run $500 per ton has been discovered on the C. N. Smith homestead four miles north of the Old Dominion mine. Smith, while building a road, uncovered a stringer four inches wide. He continued digging to a depth of 10 ft., the stringer widening. He secured an assay which showed $6.60 in silver. He obtained assistance and sunk a shaft 30 ft. At this depth the vein was eight feet wide and he reports it gave an assay of $500 per ton in silver. The outcrop shows for a quarter of a mile northeast and south-west.——At the DeSota mine, recently discovered five miles north, picked samples of ore are said to run as high as $400 in silver.

Daisy.—The Silver Mountain Mining Co. has cross-cut a vein containing ore that assays as high as $200 per ton in silver and lead. The vein is said to be 8 ft. wide.

The Silver Mountain mine is one of the old properties in Stevens county, and has been operated by William E. Seelye of Spokane and his brother for 30 years, they having expended $85,000 of their own money on development. The recent discovery is on the 400-ft. level. The present plans are to erect a concentrator at the mine. Crushing machinery is already in place.

Keller.—Sixty pounds of precipitate from the cyanide plant of the Iron Creek Mining Co. brought $8 per pound from the smelter at Kellogg. This is the product cyanided from the tailing from the concentrator. No shipment of the concentrate has been made and will not be until the railroads grant more favorable freight-rates. The mill is now entirely enclosed and is working satisfactorily. The plant handles 15 tons per day and the recovery is 87%. The mill-

feed is holding up to about $20 per ton, and the concentration is about 20 to 1.

BRITISH COLUMBIA

Hudson's Hope.—According to R. D. Featherstonhaugh, who for the last five years has been testing the gravels along the Peace and Parsnip rivers, at many points these gravels will run from $1 to $6 per cubic yard in gold, together with a small platinum content. Featherstonhaugh is making arrangements for extensive operations next spring by means of clam-shell diggers and drag-line.

Princeton.—For some time the Coalmont Collieries, Ltd., has been dumping a quantity of yellow material, found with the coal, on the waste dumps; recently samples of this mineral were sent to the Department of Mines laboratory, at Ottawa, and to a private firm of analysts, at New York. Reports from both places pronounce the mineral to be a good amber, and in future it will be segregated and a market found for it.

Prince Rupert.—H. S. Munro, general manager for the Granby company, passed through here recently on his way to New York, where he has been called for a consultation with the directors with regard to the future policy of the company. For some time the company has had an experimental concentration plant in operation at Anyox, treating a large reserve of ore that is of too low a grade for direct smelting, and it is understood that it has been demonstrated that this ore may be handled profitably with copper at 15c. per pound. For some time the company has had in contemplation the erection of a 2500-ton concentrator to treat this ore. It is likely that the plant may be started on Munro's return.

Stewart.—The S. S. 'Amur' arrived here on December 3 with a large consignment of machinery for the Premier mine, and it took south the largest consignment of concentrate yet sent from the Premier. The new ore-bunkers are completed, and by the time this is published the tramway will be in operation. The unloading terminal is an imposing structure of three stories, 210 ft. long and 36 ft. wide. The tramway enters the top story, where there is a 10-hp. gasoline engine and hoist for lifting freight that is to be sent to the mine by the tram. The ore-bunkers, which have a capacity of 1500 tons, occupy the middle of the second floor, where there also are offices and apartments for the attendants. The ground floor will be used as a warehouse; there is storage capacity for 1000 tons of sacked concentrate. There is a 20-hp. gasoline engine on this floor and an elaborate system of belt-conveyors for loading the concentrate directly on board ships. There has been a heavy fall of snow, which has stopped all mining and prospecting, except at those properties at which arrangements have been made for continuing operations throughout the winter.

Vancouver.—As the result of the verdict of the coroner's jury on the victims of the Britannia Beach disaster, the Attorney General of British Columbia has entered suit against the superintendent and engineer of the Britannia company, charging them with criminal negligence, and Wilfrid Dion, one of the miners who lost his wife, child, and household effects in the disaster, has entered action for damages. The latter is in the nature of a test case. Other writs have been issued, but these will await the decision of the Dion case. ——The Britannia M. & S. Co. is considering tenders for the structural steel part of the new mill-building. The building will be made of fabricated steel and reinforced concrete, thus obviating the chance of a second conflagration. The Britannia company will commence the re-building of the settlement at once; it will be on higher ground, where there can be no possibility of a recurrence of the flood.

MEXICO

Durango.—Plans for the construction of a mill at its mines in the Perico mountains have been made by the Rosario Mining Co. This company is composed of Americans. It has just taken over some valuable properties in the Victoria district, situated to the west of Santiago Papas-

quiaro. These mines yield ore rich in gold and silver.

Three different groups of mining claims, one situated in the Tierra Caliente mountains, another in El Ojo de Agua mountains, and the third in the Laurelos mountains, are being developed by Louis R. Goldbaum of El Paso.

Sahuaripa.—Francisco Meneses recently denounced the Los Tajos, contiguous to the Yerba Buena group east of Mulatos. This important group is owned by the Cienigita Copper Co. of Kentucky. Among other claims of this company are the Chipiona and Ostimuris. Meneses has also taken up the 'continuations' of Ostimuris where he has been smelting lead in a reverberatory furnace for some time.——Jake Biebrich, one of the American pioneers in Sonora, has installed a reverberatory at the Columbia mine west of Mina Mexico and plans to use fluxes from the Los Hoyos mine west of Arivechi in the Sahuaripa district. Freight-rates and smelter-treatment charges are so high that many in this neighborhood are resorting to the expedient of smelting their own ores.

The Mina Mexico has been working steadily for some time. The mine is producing some high-grade ore and the flotation plant is treating the second class ore and ore from the old dumps. The ore and concentrate are carried by mules to Nacozari and are shipped to the El Paso smelter.——Charles Smith of Nacozari recently took up the old Santa Rita mine about 8 miles east of Huisamopa. This mine was worked several centuries ago and has enormous dumps and evidences of a large population at one time. One of the freighters from Santa Rita discovered the Trinidad mine in the year 1750. It is planned to open the mine at once.

Torreon.—It is expected that the re-built smelter of the Penoles Mining Co. at Torreon will be finished and blown-in about January 1. This plant was moved from Penoles, in Durango, and has been much enlarged.

ONTARIO

Beaverhouse Lake.—The Argonaut will erect a mill, plans for which will be prepared early in the new year. Construction will commence in the spring. Hydro-electric power is available from Larder lake.

Cobalt.—During November the Nipissing mined ore of an estimated net value of $251,253, and shipped bullion from Nipissing and custom ores of an estimated net value of $71,807. The winze on vein 251 at 63 shaft is down 5 ft. and shows a 3-in. streak assaying 5000 oz.. The Nipissing company has taken an option on 14 silver claims in Township 188 along the Mississauga river, the ultimate consideration involved, if the purchase is carried out, being approximately $1,000,000.——At the Victory, formerly the Hylands, lateral work at 185 ft. has opened a strong vein.——The Right of Way, which recently went into the hands of a receiver, has been purchased by E. J. Daly of Montreal.

Kirkland Lake.—The Wright-Hargreaves during the third quarter of 1921 treated a total of 12,533 tons and produced $177,420 in gold, the average recovery for each ton treated being $14.15.

Porcupine.—Two new veins have been opened in a crosscut on the 1375-ft. level of the McIntyre, each being about 8 ft. wide and carrying $7 gold per ton. Part of the machinery for the 250-ton mill has arrived. The main shaft is expected to reach the 2000-ft. level in a few days and the management is preparing to start active development of the horizon between the 1500- and 2000-ft. levels.

At the Davidson a new orebody, 5 ft. wide, has been discovered at a vertical depth of 500 ft. by diamond-drilling. Assays of ore from the face of the drift on the 600-ft. level average $17.60 per ton.

Official figures show that the Dome Mines realized an income of approximately $644,052 for the third quarter of 1921. The premium on exchange will bring this up to about $700,000.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Floyd C. Merritt, of San Francisco, is at Los Angeles.

C. B. Bacon, of Berkeley, is at Mokelumne Hill, California.

L. Ehnbom has moved from Jalisco, Mexico, to Colona, Colorado.

H. G. Thiele has returned to Oakland from Dougherty, Oklahoma.

William W. Mein is expected in San Francisco at the end of this week.

K. S. Twitchell is on his way back from Sabugal, Portugal, to New York.

Alexander Leggat, formerly of Butte, Montana, has moved to New York City.

William W. Raymond, recently at El Paso, Texas, is in Chihuahua, Mexico.

F. B. Forbes has returned from the Philippine Islands to Pasadena, California.

McHenry Mosier, who has been at Avalon, California, is now at Morenci, Arizona.

George C. Bennett, formerly at Sardis, British Columbia, has returned to Redding, California.

J. S. Williams, general manager for the Phelps Dodge properties in Mexico, was at Cumpas last week.

Charles G. Yale is at St. Luke's hospital, San Francisco, recovering from a severe illness. He is convalescing satisfactorily.

Charles A. Smith, superintendent of mines for the Ray Consolidated Copper Co. at Ray, Arizona, is spending the holidays at Salt Lake City.

John M. Hayes, formerly treasurer for the Utah Copper Co., has returned to Los Angeles after a month's trip to Panama, Havana, and New York.

W. E. Thorne has returned from the tin-fields of Nigeria, British West Africa, where he has been for a short time on consulting work for Ropp Tin, Ltd., of London.

Alpheus F. Williams, general manager for the De Beers Consolidated Mines, at Kimberley, South Africa, is expected in San Francisco on account of the serious illness of his father, **Gardner F. Williams**.

J. Nelson Nevius, of Pasadena, has completed examinations of the St. Louis and Consolidated properties at Calico, San Bernardino county, and of the Argus Sterling mine near Darwin, in Inyo county, California.

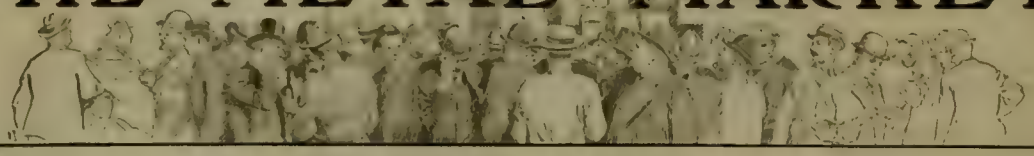
Obituary

Fredrick C. Alley died at Rosario, in Durango, Mexico, last week. He was the owner of El Carmen and other mining properties, and had been in Mexico for a number of years. He leaves a wife and five children, who had only recently returned to Mexico from El Paso, where they had lived during the revolution.

Edward C. Arnold, general mine foreman for the Federal Lead Co., at Flat River, Missouri, died suddenly at Farmington, Missouri, on December 7. He was a native of Texas and was associated with the Inde Gold Mining Co., in Durango, Mexico, for several years before coming to Flat River in 1913. He was 36 years old.

Charles F. Gleason, age 48, died of apoplexy, at Gazelle, California, on December 10. He was chemist at the Murray smelter of the American Smelting & Refining Co. for five years, and in December 1920 he was transferred to a similar position at the Tacoma plant of the company. He leaves a host of friends in Utah who deeply mourn his untimely death.

THE METAL MARKET



METAL PRICES

San Francisco, December 27

Aluminum dust, cents per pound	65
Aluminum sheets, cents per pound	60
Antimony, cents per pound	6 25— 8 25
Copper, electrolytic, cents per pound	14.75—15 25
Lead, pig, cents per pound	4.95— 5.95
Platinum, pure, per ounce	$84
Platinum, 10% iridium, per ounce	$95
Zinc, slab, cents per pound	6.75— 7.75
Zinc-dust, cents per pound	9.50—10 00

EASTERN METAL MARKET

(By wire from New York)

December 26.—Copper is quiet and strong. Lead is quiet and firm. Zinc is inactive and easier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Dec. 20	66.75	35.87
" 21	66.00	35.50
" 22	65.25	35.12
" 23	64.75	34.87
" 24	64.75	34.87
" 25 Sunday		
" 26 Holiday		

Average week ending

	Cents	Pence
Nov. 14	67.28	38.85
" 21	68.54	38.83
" 28	67.55	37.85
Dec. 5	67.27	37.35
" 12	65.46	35.44
" 19	66.08	35.60
" 26	65.50	35.25

Monthly averages

	1919	1920	1921
Jan.	101.12	132.77	65.95
Feb.	101.12	131.27	59.55
Mch.	101.12	125.70	56.08
Apr.	101.12	119.56	59.33
May	107.23	102.69	59.90
June	110.50	90.84	58.51
July	106 36	92.04	59.99
Aug	111.35	96 23	61.59
Sept.	113.92	93.66	66.22
Oct.	119 10	83.48	71.00
Nov.	127.57	77.73	68.24
Dec.	131.92	64.78	....

COPPER

Prices of electrolytic, in cents per pound.

Date	
Dec. 20	13.62
" 21	13.62
" 22	13.62
" 23	13.62
" 24	13.62
" 25 Sunday	
" 26 Holiday	

Average week ending

Nov. 14	12.88
" 21	13.19
" 28	13.35
Dec. 5	13.39
" 12	13.46
" 19	13.58
" 26	13.62

Monthly averages

	1919	1920	1921
Jan.	20.43	19.25	12.94
Feb.	17.34	19.05	12.84
Mch.	15.05	18.49	12.20
Apr.	15.23	19.23	12.50
May	15.91	19.05	12.74
June	17.53	19.00	12.83
July	20.82	19.00	12.46
Aug.	22.51	19.00	11.71
Sept.	22.10	18.75	12.03
Oct.	21.66	16.53	12.66
Nov.	20.45	14.63	13.07
Dec.	18.55	13.18	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Dec. 20	4.70
" 21	4.70
" 22	4.70
" 23	4.70
" 24	4.70
" 25 Sunday	
" 26 Holiday	

Average week ending

Nov. 14	4.70
" 21	4.70
" 28	4.70
Dec. 5	4.70
" 12	4.70
" 19	4.70
" 26	4.70

Monthly averages

	1919	1920	1921
Jan.	5.60	8.65	4.96
Feb.	5.13	8.88	4.54
Mch.	5.24	9.22	4.06
Apr.	5.05	8.78	4.32
May	5.04	8.55	5.01
June	5.32	8.43	4.57
July	5.53	8.63	4.75
Aug.	5.78	9.03	4.40
Sept.	6 02	8.08	4.61
Oct.	6.40	7.28	4.70
Nov.	6.76	6.37	4.70
Dec.	7.12	4.76	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1919	1920	1921
Jan.	71.50	62.74	35.94
Feb.	72.44	59.87	32.16
Mch.	72.50	61.92	28.87
Apr.	72.50	62.17	30.36
May	72.50	54.99	32.50
June	71.83	48.33	29.39
July	70.11	49.29	27.69
Aug.	62.20	47.60	26.35
Sept.	55.79	44.43	26.70
Oct.	54.82	40.47	27.70
Nov.	54.17	36.97	28.93
Dec.	54.94	34.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
Dec. 20	5.25
" 21	5.25
" 22	5.25
" 23	5.20
" 24	5.20
" 25 Sunday	
" 26 Holiday	

Average week ending

Nov. 14	5.23
" 21	5.18
" 28	5.14
Dec. 5	5.23
" 12	5.31
" 19	5.19
" 26	5.23

Monthly averages

	1919	1920	1921
Jan.	7.44	9.56	5.86
Feb.	6.71	9.15	5.34
Mch.	6.53	8.93	5.19
Apr.	6.49	8.76	5.33
May	6.43	8.07	5.37
June	6.91	7.92	4.96
July	7.78	8 18	4 41
Aug.	7.81	8.31	4.69
Sept.	7.57	7.84	4.74
Oct.	7.82	7.50	5 09
Nov.	8 12	6.78	5.18
Dec.	8.69	6.03	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
Nov. 29	40.00
Dec. 6	46.00
Dec. 13	52.00
" 20	52 00
" 27	48.00

Monthly averages

	1919	1920	1921
Jan.	103.75	89.00	50.00
Feb.	90.00	81.00	48.75
Mch.	72.80	87.00	45.88
Apr.	73.12	100.00	46.00
May	84.80	87.00	50.00
June	94.40	85.00	49.50
July	100.00	88.00	47.75
Aug.	103.00	85.00	47.50
Sept.	102.60	75.00	47.50
Oct.	86.00	71.00	46.25
Nov.	78.00	56.00	40.40
Dec.	95.00	52.50	....

STANDARD OIL DIVIDENDS

Standard Oil units have paid $1,833,068,166 in dividends from 1912 to 1921, inclusive. This is more than 18 times the $98,338,300 stock of old Standard Oil of New Jersey, which owned the various units at dissolution in 1911. Cash dividends aggregate $923,344,798 of the total since 1912. Stock dividends of $285,609,623 par value, distributed in the same period, are now worth $909,723,368. Adding cash payments to this value, total distributions aggregate $1,833,068,166, says the 'Boston News Bureau'.

Cash payments this year total $114,444,292. The record high year was 1920, with $115,776,793. The smallest cash payment in any of the ten years was 1915, when $62,401,204 was disbursed. The record year for stock dividends was 1913. The $81,900,000 par value of stock then distributed has a present market worth of $279,190,000. Standard Oil of New York's $60,000,000 par stock dividend, now worth $225,000,000, made up most of 1913's stock payments.

Stock dividends are still in vogue. Last year was the second largest in ten years, stocks of $58,822,987, par, having been distributed. Their present selling value is $193,436,608. Standard Oil of Indiana's 150% stock dividend was the largest 1920 item, its $52,822,987 par-value stock distributed now selling for $185,936,608. The influence of Federal taxation is evidenced in Standard Oil's stock-dividend record. No stock distributions were made in 1918 or 1919, reflecting fear of their being taxable. Following the Supreme Court's decision, holding them non-taxable, came the big distributions of 1920.

Below is presented a table showing the aggregate dividends for each year in cash, par value of stock, and present market value. Also the combined cash and market value of stock dividends for the last ten years:

	Cash dividend	Stock dividend (par value)	Stock dividend (present market value)
1921	$114,444,292	$2,000,000	$3,700,000
1920	115,776,793	58,822,987	193,436,608
1919	105,480,916	.....	.....
1918	103,480,916	.....	.....
1917	99 957,923	35,343,318	120,260,880
1916	98,627,875	29,343,318	105,385,880
1915	62,401,204	27,000,000	62,100,000
1914	63,692,884	22,000,000	43,200,000
1913	107,795,361	81,900,000	279,190,000
1912	51,686,634	29,200,000	102,450,000
Totals	$923,344,798	$285,609,623	$909,723,368

Total cash and market value of stock dividends..... $1,833,068,166

The 1913 cash-dividend payments were abnormal for that period. This was caused by the distribution of an extra 40% payment by Standard Oil of New Jersey, representing money received from former subsidiaries in liquidating loans made them prior to dissolution.

MONEY AND EXCHANGE

Foreign quotations on December 27 are as follows:

Sterling, dollars:	Cable	4.19½
	Demand	4.20
Franc, cents:	Cable	8 12
	Demand	8.14
Lira, cents:	Demand	4.35
Mark, cent:		0.55

Eastern Metal Market

New York, December 21.

A strong optimistic tone pervades all the markets. Although buying has slackened to some extent, prices are firm to higher.

The copper market is temporarily quiet as to actual buying, but prices have advanced.

A moderate business has been done in tin at higher price-levels.

Demand for lead continues steady at firmer prices.

The zinc market has advanced on prospective demand and fundamental conditions.

IRON AND STEEL

Producers of steel are not concerned over the recent slackening in demand, says 'The Iron Age'. They look on it rather as a promise of renewed buying early in the new year, since stocks have been drawn to a low point, following the replenishment movement of the fall months. It is also recognized that, next to the unsettled question of freight-rates, uncertainty as to prices is the chief influence now working on consumers of steel, ensuring a continued policy of careful buying. With the shrinkage in new business has come letting down in mill-shipments. In addition to the inventory season, some buyers are asking the holding up of shipments until after January 1, awaiting the removal of the war-tax on freight-charges.

Railroads are proceeding conservatively in placing rails. The Pennsylvania Railroad, which has considered 150,000 tons for 1922, is inquiring for 100,000 tons. The Rock Island, which still has 13,000 tons unshipped on its 1921 quota, will probably take 30,000 to 40,000 tons for next year. The Chicago Northwestern order is expected to be 10,000 tons.

COPPER

A strong tone, followed by slowly advancing prices, continues to characterize the market for electrolytic copper. Sales have not been as active as recently, but inquiry, particularly for first quarter of 1922, continues a feature. The quieter market is natural in the closing weeks of the year. There has been an advance of about ⅛c. in the week so that the minimum for December and early delivery is 13.87½c., delivered, or 13.62½c., New York or refinery, with first quarter quoted firmly at 14c., delivered, and 13.75c., New York or refinery. Prospects for good business after the turn of the year are bright, as judged by the character of the inquiries being received. Resumption of mining operations, which are now on a scale of about 40,000,000 lb. per month, is being actively planned.

TIN

While consumers have not been buyers in the past week, a fairly active business has been quietly done among dealers. The former, however, have been watching developments closely. Aside from the business among dealers, transactions on the New York Metal Exchange have been moderately active. From December 13 to 16 about 200 tons was sold at varying prices, or from 32.50c. for December to March shipment from the East on December 13 to 33.50c. for January shipment on December 16. Yesterday and Monday the edge has been taken off the market and practically nothing has been done. Prices have been hovering between 33 and 34c. for spot Straits with the quotation yesterday and Monday at 33c., New York. The continued high levels for exchange have also been a factor. The London market was about £2 per ton higher yesterday at £171 10s. for spot standard, £173 5s. for future standard, and £172 10s. for spot Straits, with the Singapore price on Monday at £174 10s. Arrivals thus far this month have been 2680 tons with 4315 tons reported afloat.

LEAD

The market continues in its steady course of a full demand, about equal to production, and at unchanged but firm prices. Interest in January delivery is active and the metal is available for that position at December prices. The leading interest continues to quote 4.70c., both New York and St. Louis, with other sellers asking 4.70 to 4.75c., New York, and 4.35 to 4.40c., St. Louis.

ZINC

Inquiry, actual or prospective, for prime Western for first quarter delivery is of fairly large proportions and the effect of this has been to strengthen the market. Quotations are higher at 4.90c., St. Louis, or 5.25c., New York, for December or 30-day delivery, with first quarter at 4.95 to 5c., St. Louis, or 5.35c., New York. Light sales have been made at 4.90c., St. Louis, for early delivery as well as 4.95c. for January. Japan continues a buyer for consumption in Japan. It is interesting to note that the volume of this buying has been so heavy in recent months that zinc exports to Japan to November 1 this year, have been 68% of the total.

ANTIMONY

There is no activity and prices are unchanged at 4.50c. per pound, New York, duty paid, for wholesale lots for early delivery. Jobbing lots are quoted at 4.70 to 4.90 cents.

ALUMINUM

Although the leading producer of virgin metal, 98 to 99% pure, quotes 19c. f.o.b. plant, for wholesale lots for early delivery, it is believed to be meeting the quotations of importers of the same grade of 17 to 18c., New York, duty paid. Demand is light.

ORES

Tungsten: No business is reported and there is consequently no change in prices which are nominal at $2 per unit for Chinese ores and $2.50 to $3 per unit for Bolivian wolframite, depending on quantity, delivery, and like factors.

Molybdenum: Nominal quotations rule in an inactive market at 45 to 50c. per pound of MoS_2 in regular concentrates of 85% MoS_2.

Manganese: There is absolutely no buying demand and quotations for high-grade foreign ore are nominal at 20c. per unit, Atlantic seaboard. Importations for 1921 will probably be close to 400,000 gross tons.

Chrome: In the absence of any demand quotations are nominal at $20 to $28 per net ton, c.i.f. Atlantic ports, depending on the grade and other considerations.

FERRO-ALLOYS

Ferro-manganese: The Steel Corporation has apparently booked 1000 tons for first half delivery with a large Ohio consumer at about $60, delivered. There are inquiries amounting to about 600 tons from three or four consumers. Prices are unchanged at a basis of $58.35, seaboard, for both British and American alloy, with the corporation's product available at $60, Pittsburgh or delivered.

Spiegeleisen: Sales of a few carload lots are reported at $26, furnace, for the 20% grade. There are inquiries for several hundred tons for export, an unusual feature of this market.

Ferro-tungsten: Nominal prices rule at 40 to 45c. per pound of contained tungsten in the domestic alloy with 50c. seaboard asked for the imported.

Ferro-silicon: The 50% alloy is available at $57 per ton, delivered, and a few sales are reported.

Ferro-chromium: Quotations for standard American alloy, 60 to 70% chromium and 4 to 8% carbon, and the imported alloy are nominal at 11 to 14c. per pound, delivered.

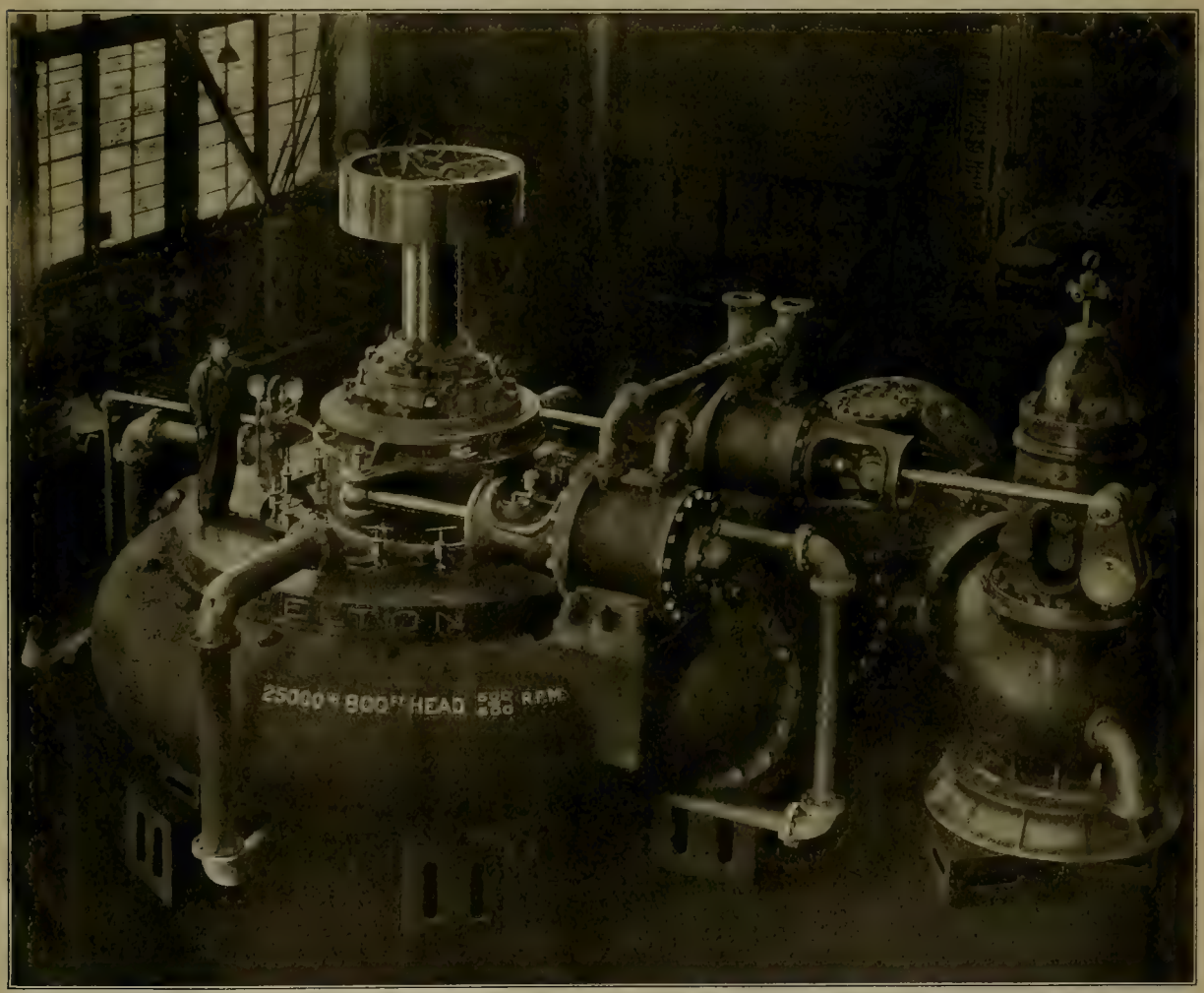
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE HIGHEST-HEAD REACTION-TURBINES IN THE WORLD

In the hydro-electric industry during the year just closing one of the most important events was the completion and placing in operation of the Kern River No. 3 Plant of the Southern California Edison Co., about 50 miles north of Caliente, California. The main power-house equipment comprises two 16,000-kw. General Electric generators driven by two 22,500-hp. vertical reaction-turbines built by the Pelton Water Wheel Co., of San Francisco. These are the highest-head reaction-turbines in the world, and operate under a head of approximately 800 feet.

Part of the Edison company's territory is served by a 50-cycle system and part by a 60-cycle system. The heaviest demand on the former comes at a different time of year from the heaviest demand on the latter system. For this reason it is desirable that the plant be equipped to deliver either 50-cycle or 60-cycle energy. Each turbine has therefore been provided with two runners, one to operate at best efficiency at 500 r.p.m., and the other at 600 r.p.m. A special design, developed and patented by the manufacturer, permits removing the lower casing cover and the upper section of the draft-tube from below, these castings being equipped with small car-wheels, secured to permanent brackets. After



Shop Assembly of One of the 800-Ft. Head Vertical Reaction Turbines Built by the Pelton Water Wheel Co. for the Kern River No. 3 Plant of the Southern California Edison Company

being disconnected, each section can readily be lowered to rails set in the concrete floor and pushed out of the way. This arrangement makes it unnecessary to disturb either the generator or the gate mechanism in order to change runners. Change of runners can be made in 20 hours, this time being reckoned from the moment the unit is taken off the line until it is again placed in service.

No storage is available at the plant, and during part of the year the entire flow of the stream is not sufficient for both turbines at full load. To provide for such periods, a cross connection is made between the turbines, and one turbine delivers 60-cycle current on a fluctuating load to the appropriate part of the system. The remainding turbine then uses whatever water remains delivering its power into the 50-cycle system. By means of the cross-connection between the units, the master governor automatically sets the load limit on the other unit so that its guide-vanes at once move to use any water rejected by the master machine on load-decrease or vice versa. The maximum available water supply is thus made to do useful work at the highest possible efficiency.

To provide for seasonal variations in the water supply, such as are caused by melting snow, a device is provided so that a rise in the water level above the penstocks causes the turbine-gates to open wider, and thus take more water, while lowering of the water level has the reverse effect.

The plant was completed and placed in operation during April of the present year, and has been in almost continuous operation since then, a large part of the time at a 10% overload, or an output of 25,000 hp. for each turbine.

WELDING 8-TON POTS BY THE OXY-ACETYLENE PROCESS

A long time ago someone with an aptitude for making phrases coined the saying, "It's easy when you know how". Of course it is not always easy, but knowing how helps a lot.

Some time ago the Bunker Hill & Sullivan company, of Kellogg, Idaho, had twenty-six 8-ton cast-iron melting-pots that had been so badly cracked in service at its smelter that they had either to be scrapped or some method of reclaiming them found. They represented an investment of $31,200. Their value as scrap would be less than a tenth that amount, from which would have to be deducted the cost of transportation to market and reduction. Naturally the alternative of reclamation was important. Attempts to weld them by the electric-arc process proved failures. The first experiments with gas-welding resulted disappointingly also, but the oxy-acetylene process seemed to offer promise of being ultimately successful, and for this reason the engineering department of one of the large apparatus manufacturers was given an opportunity to work out the problem.

In its every-day application, welding is a comparatively simple operation, in which ordinary skill and judgment are sufficient successfully to perform the work. In extraordinary applications, such as the reclamation of these ponderous pots, it is something more—it becomes an engineering problem for which practical experience and ordinary judgment are not enough. There must be an understanding of the fundamentals of the particular problem and a knowledge of how to devise the best way of dealing with the unusual situation. The engineer in this instance was equal to the emergency. He not only successfully welded several of the pots, which have since been in service for some time, but he conducted the demonstration so that other operators could proceed with the reclamation of the remaining pots. The officials of the Bunker Hill company were so well satisfied with the results obtained that they at once ordered a complete installation of the equipment used, including generators for acetylene, and in future it will be used on work of this kind and for general welding and cutting at the mine and smelter in making repairs to broken and worn machinery and plant structures.

It should not be concluded, however, that the oxy-acetylene service-engineer accomplished his demonstration without some experimenting to develop the best method of procedure. For example, when he tried to pre-heat the first pot in an improvised charcoal-furnace, he discovered that 26 sacks of charcoal burning at one time around the pot little more than warmed it. It was not until he supplemented this with a blast from an oil and compressed-air line connected with a nearby power-house, and covered the furnace and casting with asbestos paper, that he succeeded in securing the pre-heat necessary to proceed with the welding. The pots had been subjected to such high temperatures in service that a large part of the carbon was burned out as in the grate-bars of furnaces. This made it necessary to bring the pots to a high temperature before beginning to weld, in order to effect a homogeneous weld. Of course the pots were annealed after welding, to restore the original structure.

The welding demonstration described was conducted by one of the service-engineers of the Oxweld Acetylene Co.'s Seattle branch. Since then the Northport Smelter Co., hearing of the success of the work at Kellogg, has ordered Oxweld apparatus especially for the reclamation of melting-pots.

COMMERCIAL PARAGRAPHS

The machine-tool division of Pawlings & Harnischfeger Co., of Milwaukee, has just issued Bulletin 4-F, describing its new horizontal boring, drilling, and milling machine. One of the interesting illustrations included in this bulletin show how all operating levers are concentrated on the saddle. A circle with 20-in. radius includes all these levers, giving a good idea of the compactness and convenience of operation.

The Howe Chain Co., of Muskegon, Michigan, has just prepared a new 100-page catalogue, No. 121, illustrating and describing its complete lines of chains for elevating, conveying, and power-transmission. The catalogue contains full-size illustrations, complete information and data, and price-lists for all standard chains. The company wishes to place a copy of this new book in the hands of any interested party or concern.

The Allis-Chalmers Mfg. Co.'s steam-turbine is of the horizontal re-action type. It embodies the essential designs patented by Sir Charles A. Parsons, together with improvements and additions made by the engineers of this company as found desirable from years of operating experience. In this type of turbine the reduction of the pressure of the steam is subdivided into a great number of steps of small pressure drop, the steam expanding in the moving as well as in the stationary elements. These elements consist of rows of blades alternately stationary and revolving through which the steam flows. Guided by the stationary to the revolving blades, the steam expands continuously throughout the length of the turbine, alternately gaining velocity and imparting it to the revolving element, by impulse as it enters the revolving blades and by reaction as it issues from the revolving blades. There is no sudden change in pressure at any point; the reduction seldom exceeds three pounds at any one row of blades and the steam velocities are, therefore, comparatively low, resulting in long blade life. Allis-Chalmers turbines are built in various styles, depending upon operating conditions and the uses for which the units are intended. Bulletin No. 1119 describes the high-pressure single-cylinder condensing units ranging in size from about 5000 to 15,000 kw., operating at speeds of 1500 to 1800 revolutions per minute.